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**PRESERVING THE SCHOONER  
*C.A. THAYER***

**MGA J. O. No. 1650**

**Prepared by**

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10 July 1991  
Revised 9 January 1992



RESERVING THE SCHOONER  
CA TRAY

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Prepared by

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## SUMMARY

*C.A. THAYER* is a large Pacific Coast wooden lumber schooner built in 1895. Only two remain from an era when there were hundreds. She's had a long and varied history and now has National Historic Status. Since she was acquired by the museum she has received inadequate maintenance and is now in an extremely decayed condition. She continues to rot rapidly. Unless strong measures are taken immediately to arrest the decay and preserve some of the severely decayed areas, *THAYER* probably can't stay afloat past the end of this decade. If she is to survive, the level of maintenance must be increased. Patient and regular care will do much to protect her until she can be permanently preserved or restored.

The National Park Service has the responsibility of preserving the *THAYER*. There are two proven ways of doing this. One is to preserve her permanently in the controlled environment of a building. The other is to restore her completely using new material to replace all that's rotten and return her to the water. Both are large scale projects which will take years of effort and cost millions of dollars.

Hauling *C.A. THAYER* and moving her to a building will be a complicated and expensive project. The process of preserving and stabilizing her timbers will take years and must be carefully coordinated with hauling her. The total cost of moving her indoors and preserving her depends strongly on the site but will cost several million dollars. It is also unlikely that a site can be found in the vicinity of the San Francisco Maritime NHP. Any attempt to store the *THAYER* out of the water without moving her into a building and preserving her timbers will result in her rapid deterioration. Once she is properly preserved, the annual maintenance will be less than for a properly maintained vessel afloat. This alternative will allow the public to see all the vessel that is now underwater.

In the event that she is completely restored, most of her timber will have to be renewed. The deck and all of her hull above the waterline are so decayed that they must be scrapped entirely. A large percentage of the rest of the hull will have to be renewed as well, but the exact amount can't be determined until she is partially disassembled. The cost of restoring her hull and deck is estimated to be about six million dollars. This figure is based on the work being done by an independent contractor but does not include the costs of the rebuilding facility. If the restoration is done in a commercial shipyard or by federal employees, the costs will be greater. Besides restoring her former appearance and strength, this alternative would



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allow her to sail once more.



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allow for to sell once more



## INTRODUCTION

The San Francisco Maritime National Historic Park (San Francisco Maritime NHP) has the trust of the preservation of the historic wooden schooner, *C.A. THAYER*. *THAYER* is one of two surviving examples of a purely sail powered, Pacific Coast lumber schooner. She was built in 1895 by H.D. Bendixsen of Fairhaven, California to carry timber in the coastwise trade. Following her service as a lumber carrier she worked for many years in different aspects of the Pacific Northwest fisheries industry. In 1957 she sailed back to San Francisco, her first homeport, and has been a museum vessel since then. *THAYER* has been moored in San Francisco's Aquatic Park and open to the public since 1963. She is 156' long and currently weighs 558 long tons. This is small by the standards of modern steel ships, but she remains one of the biggest wooden vessels still afloat. One of the unique features of *THAYER* is her large, open lumber hold where one can see the huge timbers from which she is built.

Presently, *C.A. THAYER* is in very bad shape. Due to inadequate maintenance in the past, the wooden hull and deck have become extremely decayed. Likewise, the present level of maintenance is inadequate and not sufficient to arrest or even slow the rate at which the vessel is rotting. If she continues to deteriorate at this speed, she will soon reach a point where she can't be kept afloat. The NPS felt it needed more information prior to making any long term decisions on the preservation of *C.A. THAYER* and hired Morris Guralnick Associates (MGA) to develop this report.

This report has many different sources. At the direction of the San Francisco Maritime NHP, MGA assembled a group of noted wooden ship builders and preservationists as a "board of survey" to assist in examining and developing preservation alternatives for the restoration of *C.A. THAYER*. The committee constituted itself as the *C.A. THAYER* Preservation Committee (the Committee). Summary of the meeting and its resolutions are given in Appendix I.

The San Francisco Maritime NHP prepared a Historic Structure Report (HSR) on *C.A. THAYER* in 1990 which examined the status of the vessel and different preservation alternatives. This present document relies heavily on the HSR and it is intended to complement rather than supplant it. MGA inspected the vessel independently to confirm previous surveys and identify problem areas not mentioned in the HSR. Differences with the HSR are generally of degree and not of substance. Very often the findings of this report are



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identical to those in the HSR in which case those results are restated and cited.

MGA did new studies to assess the static forces on the vessel and her ability to resist them. Using that information, the feasibility of different remedies that had been previously suggested for strengthening *C.A. THAYER* or reducing the forces on her were examined. Also, the effects of different wood preservatives on decaying wooden ships and previous preservation efforts on other vessels were studied.

In this report, MGA examines the different preservation alternatives and comments on their practicality. In addition, this report recommends specific treatments. These recommendations were those generally approved at the Committee meeting. Any that were not specifically approved there were worked out in coordination with individual Committee members.

To aid in visualizing areas discussed in this report, the existing condition drawings, Sheets 1 through 5 from the Historical Structures Report, are located in Appendix V.



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## **IMMEDIATE PRESERVATION**

Although the biggest danger that *C.A. THAYER* faces is deterioration and decay, a sudden catastrophic loss due to sinking or fire is possible. The probability of these events occurring may be low, but the outcome of either could be disastrous. The NPS should have the proper equipment and a plan to deal with these emergencies.

### ***Sinking***

The hull of *THAYER* is generally in such bad condition that the NPS is unable to keep it watertight even in the protected environment of the Aquatic Park. Leaks in the hull have developed spontaneously, some large enough to require emergency drydocking. In addition, the topside planking has deteriorated to the degree that it lets in rain. As the hull disintegrates, the likelihood of having large leaks increases. The vessel has a tight wooden ceiling covering the frame bays. This kind of construction make it very difficult to discover leaks or deal with them at all from inside. The bilge pumping system has just been adequate to deal with previous leaks but it is unable to handle certain emergency situations.

Problem areas with *THAYER*'s bilge system and the NPS's procedures for dealing with emergency leaks are:

- A. The bilge pump (1½") is old and isn't easy to operate as it's not self priming. The make and capacity are not known nor is its condition.
- B. The pump and strainer are in the locked forepeak. Pumps of this type can be easily clogged with debris.
- C. There is a single float type bilge alarm connected to a deck alarm and by telephone line to a guard agency. This line has been disconnected since February, 1991.
- D. Most emergency personnel are untrained in location and operation of the emergency bilge pumps.

These problems could allow the vessel to sink. One can easily imagine a mooring line parting on a windy night (as it did in both 1981 and 1982) and *THAYER*'s chafing against the



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### Leaking

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These problems could allow the vessel to sink. One can easily imagine a mooring line parting on a windy night (as it did in both 1951 and 1952) and THAYER's churning against the



pier, starting a leak in her hull. As she slowly settles in the water, non watertight seams are submerged and the rate of sinking increases. The bilge alarm fails to work, is not heard, or the leak is simply too large for the pumps to handle. This is not a cheering scenario, but is very possible.

In addition, MGA's preliminary assessment of the damaged stability indicates that *THAYER* will lose positive stability sometime after the centerline keelson structure is submerged. (The principal loss comes from the bilge water sloshing from side to side in the hold. Anyone who has tried to balance a shallow tray full of water will intuitively understand this effect.) The exact point at which this total loss of stability will occur can't be determined without further study and tests. However, it will happen at some point in the flooding. In this case, she could capsize at the dock in addition to simply sinking.

New procedures to cover leaking and the possibility of sinking should be implemented for *C.A. THAYER* by the NPS. They should include:

- A. Regular testing of the bilge alarm system and emergency procedures.
- B. Unlocked or easy access to the bilge pump by emergency workers.
- C. Regular inspection of the pump and the pumping system.
- D. Emergency workers who know the location of high capacity bilge pumps and trained in their use on all the museum vessels.
- E. A daily pump out log for *C.A. THAYER*.

### ***Fire***

The immediate danger of an electrical fire is past due to recent repairs. In general, the NPS and all emergency personnel are better prepared to prevent and handle fire than they are sinking. *THAYER* is built from flammable materials, there is an operating oil fired stove on board and it is alongside a very flammable pier. Mainly, the fire prevention procedures of the NPS appear to be adequate for the protection of the vessel. However, there are certain problems that should be addressed.



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- A. There is no fire station on the pier. The closest hydrant is at the foot of Hyde Street. This will greatly delay the effective response to any serious fire.**
- B. Like the bilge alarm, the heat and smoke detectors have been disconnected from the monitoring agency since February, 1991.**



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B. Like the bridge alarm, the heat and smoke detectors have been disconnected from the monitoring agency since February, 1991.



## **SHORT TERM PRESERVATION**

*C.A. THAYER* is currently in very poor condition. The wooden hull and deck are extremely decayed and getting worse. The present level of maintenance is not sufficient to keep the vessel from rotting. If the status quo continues, *THAYER* will deteriorate to the point where she can no longer be kept afloat, much less continue as a floating exhibit. Unless she is rebuilt or the deterioration is stabilized, she is not likely to remain safely afloat past the end of this decade (HSR section 2-5.3). The goal of any short term preservation plan should be to stabilize the vessel and slow the rate of decay until she can be rebuilt or preserved out of the water. If nothing is done to arrest it, the decay will continue until there is no rebuildable structure. Different parts of the hull structure deteriorate in different ways: fastenings rust, caulking loosens, wood dries and suffers ultra-violet decay. However, the worst type of deterioration and the source of the structural problems on *C.A. THAYER* is dry rot. Unless it's arrested, the vessel will continue to decompose, like a fallen tree in the forest, until there is nothing left. Any short term preservation plan must address the causes and prevention of dry rot.

### ***Wood Decay and Preservation***

There are many organisms which cause wood to decay. For the most destructive of them, wood is food. Termites cause tremendous structural damage every year in the U.S. by eating into the foundations of houses. Ships and marine pilings are attacked by ship borers which, as their name implies, rapidly bore themselves into the wood. What is generally called *rot* is caused by the action of various species of fungi consuming the wood. There is soft rot, wet rot, dry rot, white rot - all of these are names for wood decay caused by different types of fungi. Generally, the most destructive in wooden vessels is the common brown or dry rot.

Fungi need moisture and oxygen to live. Serious rotting occurs only when the wood fibers are saturated. (This means that the rot fungi don't prosper unless the moisture content is between 30 and 80 percent, which unfortunately is the approximate moisture content of the wood everywhere in *C.A. THAYER*. Actually, rot doesn't occur at all if the wood is deprived of oxygen by being continuously immersed. That's not saying that wood does not deteriorate without oxygen; strength is slowly lost to the action of anaerobic bacteria. Also, the structure of wood changes during long immersion in water.) Wood which is subjected to periodic wetting and drying, like the waterline region of a wooden ship, is particularly prone to dry rot.



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Wooden ships in colder environments are less likely to suffer from dry rot than identical vessels in a warmer climates, as the absorption of water and the growth of the fungi are dependent on the temperature. Decay ceases when the temperature drops below 35°F or goes above 100°F. Also, vessels which are used continuously in the ocean are less likely to rot as a certain amount of salt is absorbed into the wood which helps preserve it. These are the conditions that changed for the worse when *C.A. THAYER* ended her working life at sea and became an exhibit in San Francisco. Rot fungi are everywhere in the environment and are transported (mostly by water) into the wood when the tree dies. Then the rot and deterioration of the wood begin. Rot fungi only flourish in the proper conditions. Unfortunately, these are the conditions prevailing on *THAYER*.

The topside hull planking and deck of *THAYER* have not been watertight for a long time. Rain and fresh water from deck washing have been leaking in and carrying rot fungi deep into the structure for years. As the fungus grows, it permeates the wood with microscopic strands. When it matures, it fruits and sends its spores to other uninfected parts of the wood. In a way, it is very similar to the spread of a mortifying disease like leprosy - the disease spreads from infected to non-infected areas. The topside heats in the sun all day and provides the warm and moist environment that is perfect for the dry rot fungi to thrive.

### *Wood Preservatives*

Wood preservatives can arrest the decay of wood if they are present in sufficient concentration to kill the fungi or inhibit their growth. To be effective, the preservatives must be everywhere the fungi are, i.e., throughout the wood. Preservatives in heavy petroleum bases (typically pentachlorophenol and creosote) are not absorbed by wood in any real way at normal pressures. They are not useful for wet woods. (They work by providing a physical barrier and killing any fungi on the surface of the wood. They may have some use in new construction.) Pentachlorophenol was a popular preservative for ships. However, its use is now restricted by the EPA as it is very poisonous to humans. There is a whole class of inorganic salt wood preservatives. The most commonly used is copper chromium arsenate. CCA is made to penetrate the wood by immersing the wood in a high pressure bath which also causes it to be fixed in the structure of the wood. CCA is also very toxic. Pressure treatments are obviously not useful for existing structure. Merely painting CCA or any preservative on the surface of wood has little effect. Timbers are sometimes preserved with high vapor pressure liquid fumigants such as chloropicrin and metham-sodium (Vapam). There has been some experimentation treating large timbers by injecting the fumigant through holes bored into the



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wood. However, the gas tends to escape in an uncontrolled manner through checks and defects in the timber and continues to out-gas after the treatment has been completed. Chloropicrin is prohibited in California and these fumigants are generally very toxic. There may be some use for them in preserving the present spars.

Sodium borate (disodium octaborate tetrahydrate) is a highly water soluble wood preservative that is transported in wood by diffusion. Diffusion works best in wet wood. Diffusible preservatives travel much faster through end grain than side grain and generally move fairly easily through Douglas Fir. They have the disadvantage that they will leach away along the same paths if subjected to more water after they've been applied. Sodium borate was used to preserve *MARY ROSE* and *WASA* immediately after they were raised after centuries of being submerged when the wood was still wet. More recently, it was used to arrest the rot of the steam schooner *WAPAMA*, which was dry. There is no dry rot fungus which is highly resistant to it.

The wood toxicologists (Appendix II) who have been consulted about *C.A. THAYER* agree that the use of boron in some form is probably the only useful wood preservative in her situation. The borate treatment of *WAPAMA* was very intensive but the results of it are not really known since there was no proper baseline study of the extent of the rot done before the treatment started. In addition, *WAPAMA* had already dried out for years when the borate treatment was begun; consequently, she had to be subjected to months of intensive, periodic, regular wetting with borate saturated spray to get adequate penetration. The diffusion treatment does not work through dry wood as the treatment relies on a high percentage of free water in the wood. Consequently, a spray treatment of *C.A. THAYER* will be more effective since she is not as dry as *WAPAMA* was. The success of the diffusion treatment relies on accurate control of solution strength, protection against drying out and allowing adequate time for the process to occur. A wood preservative is effective only when it reaches a certain concentration in the wood and it stays effective only so long as it remains at that concentration. However, any treatment of a structure like this is, by its nature, haphazard and the outcome difficult to predict. Any successful spray treatment will unequivocally take months if not years. Partially decayed areas or spots likely to decay in large timbers can also be protected by inserting solid sodium borate rods. Sodium borate has the added advantages of being a fire retardant and protecting timbers from wood destroying insects. Timber treated with a water soluble, diffusible preservative must be kept dry after the preservative has reached the correct concentration, or more must be constantly added.



wood. However, the gas tends to escape in an uncontrolled manner through checks and defects in the timber and continues to not gas after the treatment has been completed. Chloropicrin is prohibited in California and these fungicides are generally very toxic. There may be some use for them in preserving the present species.

Sodium borate (disodium octaborate tetrahydrate) is a highly water soluble wood preservative that is transported in wood by diffusion. Diffusion works best in wet wood. Diffusible preservatives travel much faster through end grain than side grain and generally move fairly easily through Douglas Fir. They have the disadvantage that they will leak away along the same paths if subjected to more water after they've been applied. Sodium borate was used to preserve MARY ROSE and WASA immediately after they were raised after centuries of being submerged when the wood was still wet. More recently, it was used to treat the rot of the steam locomotive WAPAMA, which was dry. There is no dry rot fungus which is highly resistant to it.

The wood technologists (Appendix II) who have been consulted about C.A. THAYER agree that the use of boron in some form is probably the only useful wood preservative in hot climates. The borate treatment of WAPAMA was very intensive but the results of it are not nearly known since there was no proper baseline study of the extent of the rot done before the treatment started. In addition, WAPAMA had already dried out for years when the borate treatment was begun; consequently, she had to be subjected to months of intensive, periodic, regular wetting with borate saturated spray to get adequate penetration. The diffusion treatment does not work through dry wood as the treatment relies on a high percentage of free water in the wood. Consequently, a spray treatment of C.A. THAYER will be more effective since she is not as dry as WAPAMA was. The success of the diffusion treatment relies on accurate control of solution strength, protection against drying out and allowing adequate time for the process to occur. A wood preservative is effective only when it reaches a certain concentration in the wood and it stays effective only so long as it remains at that concentration. However, any treatment of a structure like this is, by its nature, haphazard and the outcome difficult to predict. Any successful spray treatment will undoubtedly take months if not years. Partially decayed areas or spots likely to decay in large timbers can also be protected by injecting solid sodium borate rods. Sodium borate has the added advantages of being a fire retardant and protecting timbers from wood destroying insects. Timber treated with a water soluble, diffusible preservative must be kept dry after the preservative has reached the correct concentration or more must be continually added.



Sodium borate has a low toxicity for humans. It is an ingredient in laundry detergents and there have been no indications to date that it is dangerous. However, even if the borate treatment is confined to the inside of *THAYER*, a small amount will inevitably leach through the hull to the extent that it will be measurable in the water near the vessel. The amount and importance of it depend on the extent of the treatment. It is believed that the environmental impact will be small if proper care is exercised.

Some form of sodium borate treatment can be used effectively on *C.A. THAYER*. The dry rot can be arrested or slowed if the treatment is done well. However, it should be pointed out that wood that has been weakened or lost through decay is not renewed by the application of a wood preservative and the strength of a vessel is not increased following treatment.

### *Waterproofing the Deck*

Fresh water transports the rot fungi and wets the wood so that the rot can grow. That water comes in mostly through the deck. Consequently, the most important thing that can be done to arrest the decay of a wooden vessel is to **keep freshwater from leaking through the deck**. *THAYER*'s deck has deteriorated through neglect to the extent that it can't be made perfectly watertight by simply being recaulked. Although the bottom of the decking and the top of the beams are rotted, the upper surface is generally hard enough to be caulked. A skilled hand working year round on the decks could do much to slow the leaks. Patiently recaulking the worst seams and replacing the poorest planks would do much good. Keeping a traditional laid deck watertight takes regular maintenance. To make this deck more water resistant, the NPS must anticipate that a certain amount of seams and planking will be repaired yearly. Scraping the seams flush with the deck will help them remain watertight and will discourage rot.

The worst seam on the deck is the joint between the waterway and the covering boards. So much water leaks through now that there are mold and fruiting fungus bodies underneath. It is likely that this seam will never be perfectly watertight. However, it can probably be repaired so that it will be much more water resistant. If the paint is stripped off this area, the rotten parts can be identified and replaced. Because of the form of construction, the waterway timbers can probably be left intact. The extent of the repairs necessary can't be determined until the paint is stripped off this section. Although the covering boards are very deteriorated, they can still be much improved through daily maintenance and regular repairs.



Sodium borate has a low toxicity for humans. It is an ingredient in laundry detergents and there have been no indications to date that it is dangerous. However, even if the borate treatment is confined to the inside of T&E's, a small amount will inevitably leach through the hull to the extent that it will be measurable in the water near the vessel. The amount and importance of it depend on the extent of the treatment. It is believed that the environmental impact will be small if proper care is exercised.

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### Waterproofing the Deck

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The worst seam on the deck is the joint between the waterway and the covering boards. So much water leaks through now that there are mold and fruiting fungus bodies underneath. It is likely that this seam will never be perfectly watertight. However, it can probably be repaired so that it will be much more water resistant. If the paint is stripped off this area, the rotten paint can be identified and repaired. Because of the form of construction, the waterway supports can probably be left intact. The extent of the repairs necessary can be determined until the paint is stripped off this section. Although the covering boards are very deteriorated, they can still be much improved through daily maintenance and regular repairs.



There have been many suggestions that *THAYER* should be fitted with a cover to keep the rain out. A permanent cover will change the look of the vessel, consequently the idea of a temporary one that is re-erected every rainy season is generally preferred. Unfortunately, an unsupported awning is impractical because of the wind loads (Tri-Coastal Marine, 1987). Whether temporary or permanent, the cover would have to be relatively robust and well attached to the vessel. The present cover of *WAPAMA* gives the idea of the form and complexity of the structure. Assembling and disassembling a cover like that every year is not a minor task and it will significantly change the appearance of *THAYER* for at least five months every year.

An alternative method for keeping the water from going through the deck is to cover it with a new, permanent surface. Traditionally (since WW II), the lives of working wooden ships have been extended by covering the decks with asphaltic roofing material. This is an accepted method for working vessels and continues to be used on the East Coast and in the Gulf where it is known affectionately as "*Miami teak*". The deck is first smoothed, then roofing paper bedded down on asphaltic cement is tacked down to it. All of that is then sealed with roofing paint and several coats of normal exterior paint. A covering like this can be expected to keep the deck substantially watertight for years. It will significantly change the appearance of *THAYER* but not as much as an awning would. If the vessel is later preserved in a building, the "*Miami teak*" can be removed leaving the deck not much different in appearance than it is now. In the event *C.A. THAYER* is rebuilt, the present deck cannot be reused.

### ***Strength of C.A. THAYER***

Primarily due to the rotting of wood, the strength of *THAYER* has declined considerably from what it was in 1895. Nearly a hundred years of rot and decay have made her soft and have weakened the structure to the extent that she cannot be sailed - that much is obvious. What is less apparent is that with every year she is less able to withstand the forces of merely floating in the Aquatic Park. The severe and increasing hog she suffers from is a sign that she is succumbing to these static loads. (A "*hog*" is the characteristic humped back shape seen on many old wooden ships. The center rises up and the ends droop down - like the profile of a hog.) See photo on Page 14 of *C.A. THAYER*'s keel at drydocking of 22 February 1991.



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### Structure of C.A. THAYER

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For a body at rest, the internal and external forces have to be in balance. The external loads are due to weight, hydrostatic pressure, waves, wind and mooring forces. The total load is the sum of the external loads. If there is an imbalance in the distribution of these external loads then there must be an compensating internal load to keep the body in equilibrium. The only steady forces acting on a floating ship are weight (always down) and the water pressure force (inward on the hull). Buoyancy is the vertical part of the water pressure force. For a ship to float, the total weight and buoyancy must be equal - that's Archimedes' Principle. If the distribution of the weight and buoyancy are equal and opposite, as for a floating log, then they cause no internal forces on the structure. However, the hydrostatic pressure force always causes internal forces (as in the sides of a ship where it is unopposed by a weight force). This pressure force is proportional to the water depth - it's large for a submarine, but small for a canoe.

The internal forces coming from the unequal distribution of weight and pressure try to





For a body at rest, the internal and external forces have to be in balance. The external forces are the weight (gravitational force) acting downwards and the normal force acting upwards. If there is an imbalance in the magnitude of these forces, the body will not be at rest. For example, if the weight is greater than the normal force, the body will accelerate downwards. If the normal force is greater than the weight, the body will accelerate upwards. In a state of equilibrium, the weight and the normal force are equal in magnitude and opposite in direction, resulting in a net force of zero.

The normal force is a contact force that acts perpendicular to the surface of contact. It is a reaction force that prevents objects from passing through each other.



bend the hull longitudinally (like bending a long thin beam), and to bend the shell of the ship. For a long, thin ship with interior bulkheads the stresses caused by the first phenomenon dominate (primary direct stresses). However, *C.A. THAYER* is relatively short, shallow and wide and has no bulkheads amidships; in her the second phenomenon is also quite important (secondary stresses). Unfortunately, there's no standard method for calculating these secondary stresses in a vessel like this with few transverse bulkheads and a rapidly changing bottom geometry.

Normal practice in a thin walled steel ship is to just add these stresses (which, primarily because she is not thin walled, is not wholly correct for *THAYER*). For a vessel suffering from hogging forces, the primary stress is tensile at the deck and compressive in the bottom. Within the bottom shell, which is being pushed up by the hydrostatic force, the secondary stress is compressive on the outside and in tension on the inside. The combined stress is forcing *THAYER* to hog. An elastic structure deflects proportional to this stress and to the relative stiffness of the structure.

Stiffness comes from the shape of the structure and the materials it's built from. Material properties can change. This is especially true in wood which gets softer as it gets wet and rots. Certain shapes are inherently stiffer. A board on edge is more resistant to bending than the same board laid flat. *THAYER* is wide and shallow more like the board laid flat. Manufactured structural beams have flanges and webs. When a long "I" beam is bent, the vertical web carries the shear force between the two horizontal flanges. For a hollow girder, like *C.A. THAYER* with no longitudinal bulkheads, the shear force is carried primarily in its sides. Along the centerline, the shear stress is zero.

Structures subjected to continuous steady loads change shape through creep in the materials and the small shifts of members relative to each other. The bending stresses on *C.A. THAYER* are actually very small and the consequent elastic deflection and material creep are small. In spite of that, she now has a large (14" vertical deflection) hog in the keel. The major component of this deflection is due to the incremental, non-elastic shifting of elements of the structure. (There isn't a word for this for ships, although the process is akin to the "settling" of buildings. Together with the material creep, it will be called "creep deformation" here.) It began in earnest when *THAYER* ceased carrying cargo. When a wooden vessel decays, it gets softer and this slow creep deformation speeds up. (It can rapidly accelerate as it did with *WAPAMA* in 1980. The hog started to increase so quickly that she could no longer be made watertight and there was fear she might break up. She was hauled out on a barge where she



...and to bend the shell of the ship. For a long time with interior bulkheads the stresses caused by the first phenomenon dominate (primary direct stresses). However, C.A. THAYER is relatively about shallow and wide and has no bulkheads amidships; in fact the second phenomenon is also quite important (secondary stresses). Unfortunately there's no standard method for calculating these secondary stresses in a vessel like this with few transverse bulkheads and a rapidly changing bottom geometry.

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remains.) This creep deformation occurs mostly because of the inherent inability of a traditional wooden hull to carry sheer. In effect, the hull longitudinals slide over each other, allowing the vessel to hog. The principal mechanism that restricts this is friction between the planks in the hull and ceiling. That's why caulking is put in so tight and recaulking a vessel does so much to stiffen it. When the topside planking of a wooden ship dries, the caulking loosens and she loses much of her longitudinal stiffness.

A structure can be made more resistant to deflection, including the long term creep deformation, by either making it stiffer or reducing the stresses. There have been many suggestions about how to stabilize or reverse the hog in *C.A. THAYER* short of rebuilding her. These are all included in two main themes. The first is to reduce the internal forces by adding weight, buoyancy or a combination of the two. The second is to strengthen the vessel with added structure in the form of some sort of longitudinal girder.

### *Ballast and Buoyancy*

MGA calculated the distribution of the weight and buoyancy for *THAYER* to determine the internal forces which are operating on her and to assess the practicality of potential remedies. The distribution of the vertical internal forces is usually expressed as a longitudinal bending moment. The bending moment at a point due to a force depends on the magnitude of the force and its distance from the point. Bending moment curves are indications of how much a beam will bend. A graph of the longitudinal bending moment for the vessel in its present state is included in Appendix III.

The addition of ballast is the least expensive way to correct the hogging forces. (Lead prices fluctuate between thirty and forty cents per pound.) The second loading curve (Appendix III) shows that the midship longitudinal bending moment can be made zero by adding approximately 225 long tons of ballast amidships. This is slightly over 700 cubic feet of lead or about 3600 cubic feet granite ballast. This may be acceptable, but the ballast will lower *THAYER* an additional twenty inches in the water. The planking immediately above the present waterline is very deteriorated and is presently not watertight. Repairs would have to be made to the planking before adding all this ballast. In addition, there is a real question as to whether the bottom can support this much weight.

The longitudinal bending moment can also be made zero by adding 125 long tons of ballast amidships and twenty five tons of buoyancy at each end. This has the advantage of only



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immersing the vessel an additional five inches. Twenty five tons of buoyancy is equivalent to 875 cubic feet of air - about the volume of a small bedroom. It should be apparent that added buoyancy is only effective if it is submerged. *C.A. THAYER* is presently moored at a site with strong surge and tidal currents. For these reasons any buoyancy chambers would have to be strongly built and well attached to the vessel with provision to sound and pump them out. Simple steel chambers, built in a shipyard, that would fulfill these criteria would cost about \$60,000 to fabricate. There are potential pitfalls associated with the addition of buoyancy chambers that could harm the vessel. Even if they are very carefully built and the buoyancy is slowly added, the chambers will bear unevenly on the hull. This could be a problem as could be the unknown effect of suddenly flooding a chamber.

To some extent, the progressive hogging of a vessel is self limiting. As the vessel humps up and the ends droop, the hogging forces diminish. Whether this occurs before *C.A. THAYER* breaks in two is problematical. However, if the forces can be diminished, failure is less likely. The bending moment can be reduced to about half of the present by adding 125 long tons of ballast. Slightly less than half of this in lead would fit under the present bilge boards. There remains the question about whether the bottom can support ballast. The only way this can be determined is by adding it in incremental amounts and checking the deflections.

### *Structural Reinforcement*

In the past, there have been many suggestions that *C.A. THAYER* and vessels in a similar predicament should be strengthened to resist hogging by adding some kind of longitudinal girder or truss to their structures. As was stated previously, the bending stresses are very small, but they continue to cause creep deformation. If the vessel is to be prevented from suffering further hogging, the safest design is one where the added structure takes the entire bending load. A first approximation for a steel box girder sufficient to carry this load shows it would have to be five feet high and weigh about fifty tons. The fabrication alone would probably cost over \$200,000. A more refined design or the use of other materials might reduce the cost or the size somewhat, but it will remain large, heavy and expensive. If something like this were added inside the vessel, it would significantly change the character of the hold. If it were added to the bottom of the keel, *THAYER* would ground out in her present berth. It should also be mentioned that although installing some kind of new structural reinforcement like this has been suggested for other wooden ships, it has never been done. The local effects of adding a large, rigid reinforcement like this are not known and must be regarded as experimental.



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Theoretically, new structure would not have to carry the entire bending load as *THAYER* does have some strength - if she didn't, like a piece of cooked spaghetti, she would immediately fold in half. Determining how much strength she does have is the problem. Much less new structure would have to be added if it could be effectively added to the existing structure. If this course of action is selected, some experiments need to be conducted to the ship in order to determine the approximate strength of the hull. The design of this new auxiliary structure would need to take into account further deterioration of the wood in the future.

The Historic Structure Report (HSR) recommended that the lowest strake of bilge ceiling should be removed to increase air circulation in the frame bays and to allow inspection of the lower keelsons, keel and floor timbers. The *C.A. THAYER* Preservation Committee agreed with this although there were some reservations about the loss in strength. If *THAYER* were a homogeneous beam (if there were no shearing of the longitudinals) then the loss of longitudinal strength would be slightly less than one per cent. Since the longitudinals do slip past each other, the actual strength loss is less. There would be no effective loss of transverse strength.

The void under the fisherman's forecastle is rotten to the extent that large chunks of ceiling plank and frames have disintegrated and the hull planking is visible. There is putrefying water in the frame bays and the area continues to decay rapidly in the dank atmosphere. It is presently "out of sight out of mind"- it appears to be rarely visited by maintenance personnel. Ventilation and inspection of this area need to be increased. It was suggested in the HSR that the forecastle bulkhead be removed beneath the line of the forecastle sole and that there should be some forced ventilation to dry this area out to slow the decay.

### *Recommendations for Short Term Preservation*

All of these recommendations should be implemented immediately. They can all be done without dry docking *C.A. THAYER* or removing her from service for extended periods. The deterioration of the vessel is due to many interrelated effects and, although implementing any one of these recommendations will help, it is preferred that they all be done. Some of these items are covered at length in the HSR (Section 2-6.3). They are repeated here to emphasize their importance.



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#### Recommendations for Starboard Forecastle

All of these recommendations should be implemented immediately. They can all be done without dry docking C.A. THAYER or removing her from service for extended periods. The deterioration of the vessel is due to many interrelated effects and, although implementing any one of these recommendations will help, it is preferred that they all be done. Some of these items are covered in length in the HSR (Section 2.6.3). They are repeated here to emphasize their importance.



- A. Cease all fresh water washing of the deck immediately. If salt water is not available, do not wash the deck.
- B. Remove the lowest strake of bilge ceiling port and starboard. Clean and examine this area. Clean the limber holes. The practicality and cost of rebuilding *C.A. THAYER* depend on the condition of the centerline structure and lower framing which is largely unknown. The type of floor timbers and the location of joints in the centerline timbers can be discovered once this piece is removed. Also, its removal will aid the drying of the frame bays once the borate treatment is completed. The ventilation, cleaning and inspection of all parts of the interior should be increased. The bottom of the forecastle bulkhead should be removed as outlined in the HSR (Section 2-6.3.2).
- C. Begin treatment with sodium borate solution. The NPS has all the material, equipment and manpower necessary to begin preserving the wood of *C.A. THAYER* now. Additional costs will be very small. Since she is moored in the Aquatic Park and any extensive runoff would probably cause public concern, the main treatment should be less extensive than that of *WAPAMA* and confined primarily to the interior of the vessel. During the treatment, *THAYER* will remain open to the public above deck.

The principal object of this treatment is to arrest the further decay of the lower framing, floor timbers and centerline timbers. The conservation of the deck, the hull above the waterline and the deck structures is of secondary importance. The deck is so decayed that no part of it can be used in a future reconstruction. The cabin and deck house are somewhat decayed, but they are not important to the survival of the vessel. The deck and superstructure are very dry and any treatment with a diffusible preservative relies on the surfaces being kept wet. However, localized treatment of visibly rotted areas may have some use. Extensive treatment of the deck would require removing *C.A. THAYER* from service. The consequent runoff would probably be unacceptable.

The entire interior of *THAYER* should basically be soaked with borate solution. A PVC pipe spray should be rigged adjacent to the air strake in the ceiling so that it sprays into the frame bays several times a day. A single pipe should deliver a spray to the top of the bottom longitudinals. The sprays should be applied frequently enough so that all the surfaces in the interior of the hold are always saturated allowing the chemical to diffuse into the wood. Portable sprayers should be used on a daily basis to



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saturate the surfaces of the stem and stern framing and any surface not reached the spray installation. The area around the frame heads beneath the covering board should receive special attention.

The sodium borate saturated water will collect in the bilge and will diffuse into the floor timbers, lower futtocks and keel. This effluent can simply be filtered and reused. Periodically it may be necessary to empty the bilge, in which case it can be pumped out with a portable pump and disposed of properly. Sodium borate is an ingredient of some laundry detergents and is non-toxic to humans. The treatment will continue until test boring indicates that the chemical has reached satisfactory levels in the wood. In no case should the treatment be ended in the rainy season.

- D. Repair the deck. Strip the paint from the waterways and covering board and assess the extent of the rot there. Repair the rotten areas. Scrape the deck. Identify the worst seams and deck planks and repair them. Begin a program of daily and regular maintenance designed to make the deck watertight.
- E. There must be increased routine maintenance of the hull above the waterline. More effort should be spent on the inspection and repair of topside hull planks and seams. The entire topside of the vessel must be painted yearly. This work must precede any addition of ballast.
- F. Add ballast to decrease the bending moment. One hundred and twenty-five long tons of ballast centered at frame #32 should be added in the hold of *C.A. THAYER*. The ballast will be distributed approximately uniformly over forty feet of the bottom. About fifty tons can be stored underneath the present bilge boards. Ability of the vessel to support this ballast is presently unknown and it should be added incrementally. The effect of adding each increment of weight should be measured by an engineer. These measurements will be used to calculate an approximate strength of the hull "girder" and as an indicator of the local strength.



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D. Repair the deck. Strip the paint from the waterways and covering board and assess the extent of the rot there. Repair the rotten areas. Scrape the deck. Identify the worn seams and deck planks and repair them. Begin a program of daily and regular maintenance designed to make the deck watertight.

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## **LONG TERM PRESERVATION**

**C.A. THAYER** has National Historic Status. By law, the National Park Service must preserve it forever. No one will argue about the meaning of the word forever, but there is a continuous and spirited debate about what is meant by preservation. "Preserve" as defined by the American Heritage Dictionary of the English Language is, "1. To protect from injury, peril, or other adversity. 2. To keep or maintain intact. 3. To treat or prepare so as to prevent decay." Definitions 1 and 3 are self-explanatory. However, definition 2, "*To keep intact (or whole)*" can have several meanings. There is a world of well held positions in the debate; however, the argument is plainly shown by two held by pure preservationists at the polar extremes. The first demands the preservation of the historic fabric. Essentially, the vessel would be preserved as a relic. The wood itself is preserved much as one saves fragments of the true cross. A problem with this is that the exterior of **THAYER** has been changed and repaired many times in the past. All parts do not have the same historical significance.

At the other extreme, the form and function of the ship must be preserved - the wood alone is meaningless. From this view point, the ship should be rebuilt and sailed in the same way she was in 1895. The methods of building and sailing a wooden ship is viewed as being more important than the preservation of the vessel itself. The ideal of this type of restoration is that **C.A. THAYER** remain intact in the water, even though she becomes a replica of the original. If she needs to be rebuilt one hundred years from now, her construction will be like the original and will guide the future generation. A structure which is heavily modified or patched together will tell them little about the original construction method.

**THAYER** can't be preserved as a floating exhibit indefinitely without rebuilding her. Based on previous surveys (HSR Section 2-2.4), most of the hull and deck are rotten. So much strength has been lost due to this deterioration that the hull is unable to withstand the static forces that are on it in the Aquatic Park. Even if the rot is completely stopped, that strength won't be restored. To remain afloat, a majority of her significant, historical structure must be rebuilt in some fashion. "Full restoration" implies the complete rebuilding of **C.A. THAYER** by replacing all damaged parts with identical new material with the intention that the original strength and appearance of the vessel be restored.

Full restoration with in kind replacement of damaged material is the traditional method of restoring old wooden vessels. The biggest plus to this method is that it would return **THAYER** to her original appearance and strength, with the great appeal of permitting the vessel to sail







once again. *THAYER* can be restored to exactly the same condition as she was when she was built by H.D. Bendixsen almost 100 years ago. If the new wood is treated with wood preservatives and the vessel is properly ballasted to reduce bending stresses, the vessel can be preserved for the next hundred years with regular maintenance. However, it should be clear that the maintenance required to keep the renewed vessel healthy is substantially greater than what she receives now.

There are several large wooden vessels in the U.S. that have been restored with extensive rebuilding. The oldest and best documented of these is *USS CONSTITUTION*. She was built in 1797 and had major rebuilds in 1833, 1874 and 1927. Very little of her original structure remains. Rather like *C.A. THAYER*, these restorations have been in reaction to a shocking deterioration in the vessel. Since her last drydocking in 1973, the *CONSTITUTION* has had a dedicated maintenance facility and consequently has decayed very little since then from rot. Her keel was completely straightened in the 1927-31 rebuild but she began to hog rapidly when relaunched. Because of the recent high level of maintenance, the hog has increased very little since the last drydocking. Another major reconstruction is planned in advance of the 200th anniversary of the vessel in 1997. The plans are to straighten the vessel and incorporate new, reinforced plastic structure that will carry the entire bending load and prevent future hog deformation. The rebuilding will mostly be done by an independent contractor in *USS CONSTITUTION*'s drydock facility.

The current state of *CONSTITUTION* is very different from *C.A. THAYER*. First of all, *CONSTITUTION* has very little rotten material. Secondly, although both vessels have about fifteen inches of hog in their keels, *CONSTITUTION* is a much bigger ship and the magnitude of the forces causing her to hog are only half of those of *THAYER*. The proposed new structure for *CONSTITUTION* is quite elaborate, but is completely beneath the orlop deck - hidden from public view. In addition, it has been designed to resemble structure that was in the vessel before the last rebuild. A similar structure is really not feasible for *C.A. THAYER*.

Mystic Seaport Museum has done complete restorations on several large wooden vessels. The standard of maintenance there is excellent and the wood in these vessels has decayed very little since the restorations. In spite of this good maintenance, these vessels have all suffered to some degree from structural creep deformation. The Museum has its own dedicated repair facility, lift dock and work force.

The North End Shipyard in Rockland, Maine, specializes in this type of restoration and



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has completely rebuilt several passenger carrying "dude" schooners. Commonly, they haul the vessel at the end of their sailing season, dismantle and rebuild it almost entirely, and launch it before the next season begins. Their facility is simple and very much like a nineteenth century shipyard. Many of the workers who have trained at the North End Shipyard are now independent contractors.

Evidently, full restoration is a feasible alternative. Wood and the other necessary materials are available. Douglas Fir is not as cheap or as plentiful as it was in 1895, but it is possible to get the long lengths and quality of timber comparable to the original. The expertise to rebuild the vessel also exists. There's been a small renaissance of wooden ship building in the last fifteen years in this country. Groups of professional builders travel around the country building historic replicas and rebuilding old wooden ships (Appendix II). There are local firms that are fully capable of doing this restoration. The procedure for the full restoration is detailed in the HSR (Section 2-6.4).

Once the decision to fully restore *THAYER* is made, the timber should be bought at once, brought to the building site and properly stored. The wood should be treated with a preservative prior to storage. Sodium borate seems to be the most promising and the least expensive. Although *C.A. THAYER* probably wasn't built with perfectly dry wood, her deck and topside were often wet, and she mostly stayed in a colder and moister climate. Sitting at the dock in San Francisco Bay, that wood just gets drier and drier. Consequently, it's very important that the deck and topside hull planking be air dried to a moisture content of ten per cent or less before installation. Otherwise, when this wood dries, it shrinks - that opens up the seams which lets in rain water and causes rot. Also, when the caulking loosens in the topside planking, the ability of the hull to resist bending is decreased. All the above waterline timbers should be purchased far enough in advanced to insure they have the proper low moisture content when they are installed.

The sequence that should be followed during the restoration is not exactly that outlined in the HSR (Section 2-6.4.7). It's true that the extent of the rebuild and the exact schedule can't be determined until the vessel is partially disassembled and the rot in the centerline timbers is assessed. However, based on previous ships that were not as rotten as *C.A. THAYER* and were completely rebuilt, very little of her can be saved. The amount of retained historic fabric will depend greatly on its condition and the amount of effort (and money) the NPS is willing to invest. It would be very misguided to try and save her existing shape, as it is severely distorted. After the vessel is hauled it should be dismantled entirely until only sound wood remains.



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Then she will be rebuilt using new wood to a fair set of lines that is the best representation of the vessel when she was new in 1895.

The essential requirements for the restoration facility are given in the HSR (Section 2-6.4.5). That report mentioned the ideal nature of the smallest drydock in the Hunter's Point Naval Shipyard as a repair facility. It has all the tools and buildings necessary to do this job. The Preservation Committee thought the same and strongly recommended that the NPS get the use of it for repair of all the large vessels in the collection.

Typically, these wooden ships were built by robust men in very modest facilities. *C.A. THAYER* can be rebuilt at a site that is far less well equipped than the Hunter's Point Drydock is. The HSR mentions the possibility of rebuilding the vessel on a barge alongside the Hyde Street Pier, which would let the public see the work as it's done. This is feasible, although working on a barge or a floating drydock complicates the process by adding the difficulty of transferring material from land to the floating facility. In addition, the rebuilding process will generate tons of wood chips and dust which will be a problem in the Aquatic Park. Actually, the most efficient site would be on solid ground that's on the same level as the machinery and wood storage. She could be hauled on a marine railway for a major rebuilding like this, although there is only one railway big enough left in the San Francisco Bay Area. It is highly unlikely that the private owner would consider tying up his facility for the time needed. In any case, it's made clear in the HSR that the costs associated with setting up a suitable facility, will only be a small fraction of the total restoration cost.

A reconstruction that restores *C.A. THAYER* to the identical condition she was in 1895 does nothing to address the forces which have caused her to hog over the last ninety-six years. As was previously mentioned, she can be ballasted so that the internal forces that cause the bending are reduced. Ballasting is more attractive for the renewed vessel since she can be expected to withstand the local ballast loads and the new topside hull planking will be watertight. Although Bendixsen was an expert builder and *THAYER* was constructed from the best Douglas Fir, she was not rationally designed from a structural perspective. At the time, steel was relatively expensive and wood was cheap. The long lengths of the timbers in her clamp and deck did quite a bit to preserve her shape over the decades. However, many of her timbers were not arranged in a way that achieved the best affect.

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There are many misconceptions about the structure of ships. One idea that has persisted is the importance of the "backbone" in stiffening a vessel. Wooden ships hogged principally



because of the inability of the sides of the ship to carry the shear forces which arises from the primary stresses. Typical turn of the century West Coast wooden ships had huge keel/keelson backbones which actually did little for longitudinal strength because the shear stress is nearly zero there in a homogeneous beam. To be truly effective, a keel assembly like this would have to be much stronger in both shear and bending and would have to carry the entire bending load. That means it would have to be built out of metal or some other strong material.

If the vessel is rebuilt, it makes sense from an engineering point of view to incorporate some high strength material into the structure to minimize any future creep deformation. Any added structure will have to be extensive to be effective. Probably the only structure that could be completely hidden is diagonal metal strapping in the hull between the frames and hull planking. This method was a traditional East Coast 19th century wooden shipbuilding technique. Adding any new material, even if hidden in the existing structure, may be unacceptable to strict preservationists.

A disadvantage of total reconstruction is that much of the patina of age will be lost. There has been discussion of the uniqueness of the cargo hold and the importance of retaining the ceiling planks. Indeed, the condition of the ceiling appears to be good in the cargo hold, but that belies the actual state of decay. The HSR illustrates how the surfaces of the ceiling planks could be laminated to new timber. However, due to the decay of the timbers and the fact that they were fastened and edge bolted with steel makes it very unlikely that these planks can be removed in one piece. If the NPS feels that preserving historical fabric with such techniques is necessary, the restoration cost will rise significantly. Traditionally in wooden ship building, it has been considered bad practice to repair a piece of wood that had more than a small amount of rot in it. If a timber were partly decayed, it was removed entirely and replaced with new. Based on the survey results from the HSR, most of the timber in the vessel must be renewed.

Another drawback to complete restoration is the cost. The HSR (Section 2-7) estimated the cost of rebuilding *C.A. THAYER* hull and deck to be about six million dollars. This figure is based on most of the work being done by an independent contractor in a dock belonging to or controlled by the NPS. (However, it doesn't include the costs of that facility.) If the rebuilding is done in a commercial yard or by civil service employees of the NPS, the costs will be higher.

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Another drawback to complete restoration is the cost. The HSR (Section 2-7) estimated the cost of rebuilding C.A. TWAVER hull and deck to be about six million dollars. This figure is based on most of the work being done by an independent contractor in a dock belonging to or controlled by the NPS. (However, it doesn't include the costs of that facility.) If the rebuilding is done in a commercial yard or by civil service employees of the NPS, the costs will be higher.

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of the vessel that is saved. Indeed, for a severely rotten ship like *THAYER*, it's usually cheaper and gives better results if an entirely new vessel is simply built on the keel of the old vessel. That's owing to the relative difficulty of fitting new pieces to old.

The fastest and most efficient method of rebuilding *C.A. THAYER* is to do it in a single stage at a suitable facility. Then she can be dismantled enough so that the hog can be removed entirely from the keel and the hull can be returned to its original shape. It has been suggested that the hull and deck be rebuilt in stages to spread the costs over a longer period. This process is very much more difficult than new building, generally takes more fitting and requires the use of shorter pieces of timber. This piecemeal approach is discussed at length in the HSR (Sections 2-5.6.1 & 2-5.6.2) which states that the result would be weaker and generally inferior to the single step approach. This method will build the hog deformation into the vessel. An even worse job inevitably results from attempting to rebuild major parts of a vessel while it is afloat. Hogging forces become unrestrained when the deck and topside hull structure are removed. Hog and structural deformation in general are inevitably increased during this process. Rebuilding a vessel while it is floating has been attempted many times in the past, but never with a good result. *THAYER* is so decayed and weak that the vessel may not survive the attempt to rebuild her in this fashion.

The complete restoration is not the kind of task that can be accomplished by simply handing it over to a commercial yard. There is no existing shipyard in San Francisco Bay that has the knowledge or the ability to rebuild *C.A. THAYER*. It's been suggested that the NPS acquire its own repair facility to maintain its fleet of vessels. The HSR cost estimate is predicated on the work being mostly done by an independent (non shipyard) contractor in such a facility. This approach will result in the best job at the lowest cost.

#### *Alternatives to Full Restoration*

As was previously stated, the NPS is bound by law to preserve *C.A. THAYER* forever. Undoubtedly, the best way to preserve the existing fabric of the vessel is to haul her ashore and preserve her in a building. This has been done with varying degrees of success to several large wooden vessels in the past.

*WASA* is a 1400 ton Swedish warship that sank on her maiden voyage in 1628. She laid undisturbed in the cold waters of Stockholm harbor for almost 350 years until she was raised in 1962. At 110 feet, the water pressure is about fifty p.s.i. - a pressure far greater than that used



of the vessel that is saved. Indeed, for a severely rotten ship the THAYER is usually cheaper and gives better results if an entirely new vessel is simply built on the keel of the old vessel. That's owing to the relative difficulty of fitting new pieces to old.

The fastest and most efficient method of rebuilding C.A. THAYER is to do it in a single stage at a suitable facility. Then she can be dismantled enough so that the hog can be removed entirely from the keel and the hull can be returned to its original shape. It has been suggested that the hull and deck be rebuilt in stages to spread the costs over a longer period. This process is very much more difficult than new building, generally takes more fitting and requires the use of shorter pieces of timber. This piecemeal approach is discussed at length in the HSR (Sections 2-2.6.1 & 2-2.6.2) which states that the result would be weaker and generally inferior to the single step approach. This method will build the hog deformation into the vessel. An even worse job inevitably results from attempting to rebuild major parts of a vessel while it is afloat. Hogging forces become unbalanced when the deck and topside hull structure are removed. Hog and structural deformation in general are inevitably increased during this process. Rebuilding a vessel while it is floating has been attempted many times in the past, but never with a good result. THAYER is so decayed and weak that the vessel may not survive the attempt to rebuild her in this fashion.

The complete restoration is not the kind of task that can be accomplished by simply hauling it over to a commercial yard. There is no existing shipyard in San Francisco Bay that has the knowledge or the ability to rebuild C.A. THAYER. It's been suggested that the WPS acquire its own repair facility to maintain its fleet of vessels. The HSR cost estimate is predicated on the work being mostly done by an independent (non shipyard) contractor in such a facility. This approach will result in the best job at the lowest cost.

#### Alternatives to Full Restoration

As was previously stated, the WPS is bound by law to preserve C.A. THAYER forever. Undoubtedly, the best way to preserve the existing fabric of the vessel is to haul her ashore and preserve her in a building. This has been done with varying degrees of success on several large wooden vessels in the past.

WPS is a 1400 ton Swedish warship that sank on her maiden voyage in 1828. She laid undamaged in the cold waters of Stockholm harbor for almost 200 years until she was raised in 1902. At 110 feet the water pressure is about 850 psi - a pressure far greater than that used



for commercial wood preservative pressure treatments. The water penetrated her oak timbers completely and caused the cells in the wood to swell and rupture. Because of the low temperature, the salt, the lack of oxygen and the dearth of ship worms in Stockholm harbor, her timbers are essentially undecayed. When she was raised, the principal problem was to introduce a substance into the wood that would replace the water as the wood dried. If this isn't done, the wood rapidly "debulks" where it dries in a non uniform manner causing it to change shape, split and even disintegrate. As soon as she was taken out of the water she was moved to a climate controlled building where the air pressure was kept slightly above atmospheric. She was constantly sprayed with a solution of polyethylene-glycol (to replace the lost intra-cellular water) and sodium borate (wood preservative). The actual preservation process took over twenty years - far longer than was originally planned. Today, the *WASA* is in nearly original condition. She is the number one tourist attraction in Sweden. Last year she had five million visitors. Her preservation and restoration have been a complete success.

In contrast with *WASA*, which is nearly completely restored, *MARY ROSE* is merely a relic. *MARY ROSE* is a Tudor warship (a 700 ton carrack) that sank in 1545 when she was thirty-five years old. Only a fragment of her hull remained when she was raised in 1982. The hull fragment was so fragile that it had to be lifted on an elaborate frame. She rests today on that frame in a climate controlled, covered drydock. The timbers remain delicate and are sprayed with chilled water most of the day. Her timbers were also preserved with polyethylene-glycol and sodium borate.

The polar ship *FRAM* was built in 1892 for the Norwegian explorer Nansen's attempt to drift with the pack ice to the North Pole. This is an extremely famous vessel and is regarded as a monument in Norway. *FRAM* is 128' long, 36' of beam and displaced 800 tons when afloat. She is approximately the same size and age as *C.A. THAYER*, but far more heavily built and having a much stronger structure. After she retired from polar exploration in 1914, she returned to Norway and was derigged and neglected for ten years. In 1925 her former captain began efforts to preserve her and in 1934, following his death, she was removed from the water and a glazed building was erected over the re-rigged ship. She has received good maintenance since then and is well preserved.

Like *FRAM*, *ST. ROCH* was very strongly constructed for polar exploration and navigation in the ice. She was built for the Royal Canadian Mounted Police in 1928 and was famous for two voyages through the Northwest Passage. She is 104' long and weighs 232 tons. She retired from the RCMP in 1954 and was purchased by the City of Vancouver, B.C. She was



for constant wood preservative pressure treatment. The water penetrated her oak timbers completely and caused the cells in the wood to swell and rupture. Because of the low temperature, the salt, the lack of oxygen and the density of shipworm in Stockholm harbor, her timbers are essentially undamaged. When she was raised, the principal problem was to introduce a substance into the wood that would replace the water as the wood dried. If this isn't done, the wood rapidly "shrinks" where it dries in a non uniform manner causing it to change shape, split and even disintegrate. As soon as she was taken out of the water she was moved to a climate controlled building where the air pressure was kept slightly above atmospheric. She was constantly sprayed with a solution of polyethylene glycol (to replace the lost intra-cellular water) and sodium borate (wood preservative). The actual preservation process took over twenty years - far longer than was originally planned. Today, the WASA is in nearly original condition. She is the number one tourist attraction in Sweden. Last year she had five million visitors. Her preservation and restoration have been a complete success.

In contrast with WASA, which is nearly completely restored, MARY ROSE is merely a relic. MARY ROSE is a Tudor warship (a 700 ton canteen) that sank in 1545 when she was thirty-five years old. Only a fragment of her hull remained when she was raised in 1982. The hull fragment was so fragile that it had to be lifted on an elaborate frame. She rests today on that frame in a climate controlled, covered drydock. The timbers remain delicate and are sprayed with chilled water most of the day. Her timbers were also preserved with polyethylene glycol and sodium borate.

The polar ship FRAM was built in 1892 for the Norwegian explorer Nansen's attempt to drift with the pack ice to the North Pole. This is an extremely famous vessel and is regarded as a monument in Norway. FRAM is 128' long, 36' of beam and displaced 800 tons when afloat. She is approximately the same size and age as C.A. THAYER, but far more heavily built and having a much stronger structure. After she retired from polar exploration in 1914, she returned to Norway and was designed and neglected for ten years. In 1922 her former captain began efforts to preserve her and in 1934, following his death, she was removed from the water and a glazed building was erected over the re-rigged ship. She has received good maintenance since then and is well preserved.

Like FRAM, ST. ROCH was very strongly constructed for polar exploration and navigation in the ice. She was built for the Royal Canadian Mounted Police in 1928 and was famous for two voyages through the Northwest Passage. She is 104' long and weighs 235 tons. She retired from the RCMP in 1954 and was purchased by the City of Vancouver, B.C. She was

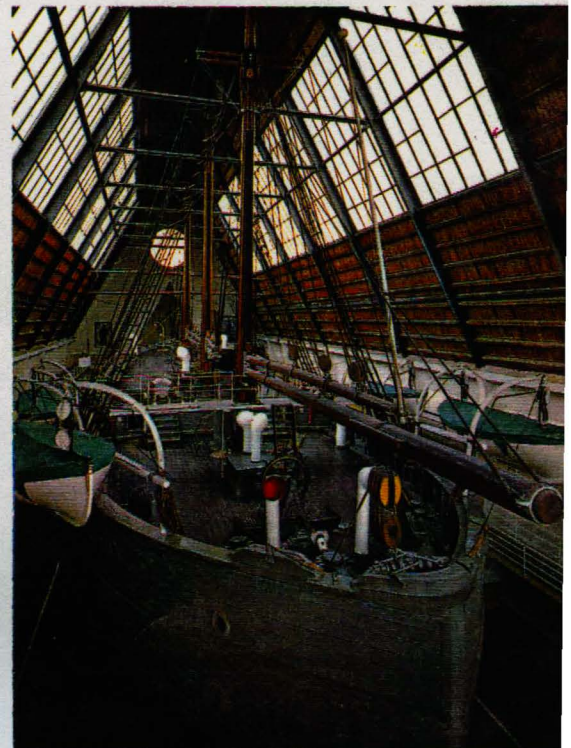
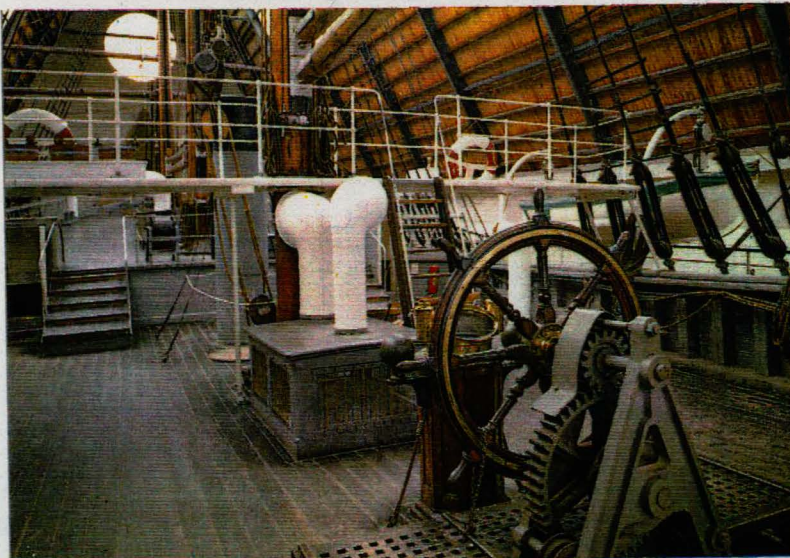
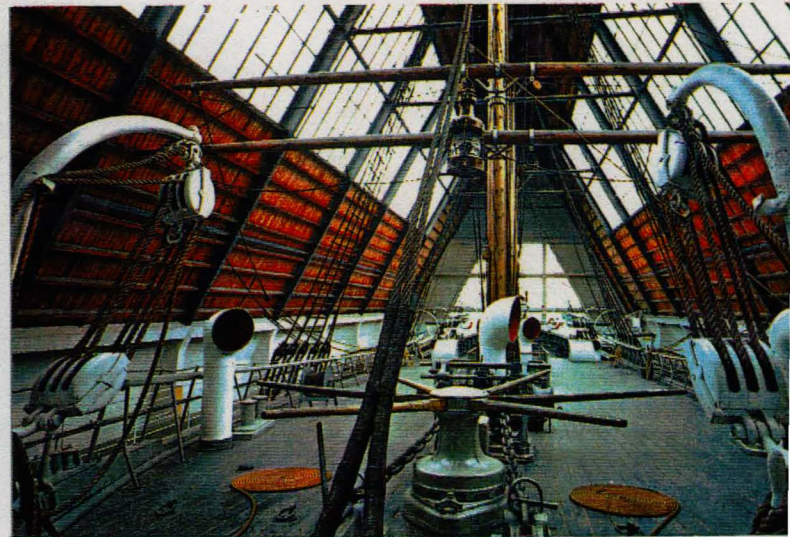
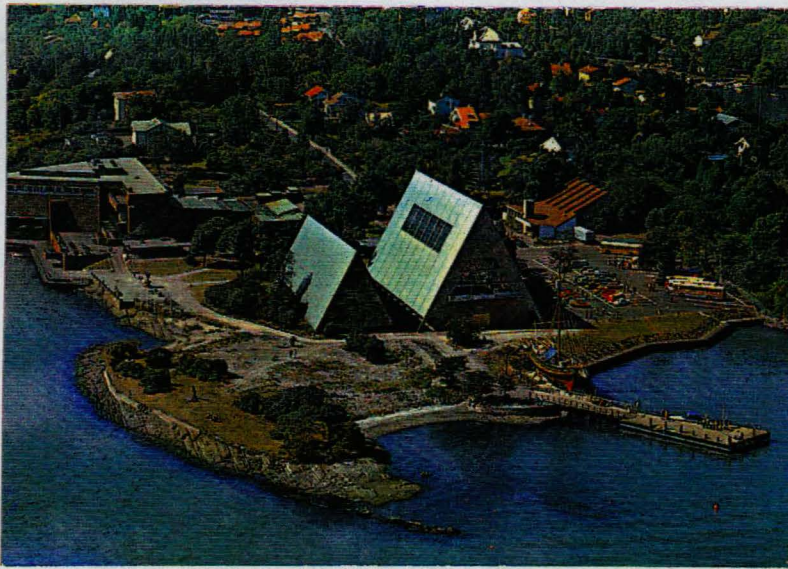


permanently drydocked in 1958 and enclosed in a building in 1966 (see photos on Page 29). Although she was in good condition when she was drydocked, the timber was never properly preserved. In addition, the moisture and temperature in her building fluctuates which allows her to slowly decay. She is presently awaiting a major restoration.



permanently drydocked in 1958 and enclosed in a building in 1966 (see photos on Page 30). Although she was in good condition when she was drydocked, the timber was never properly preserved. In addition, the moisture and temperature in her hulling timbers which allow her to slowly decay. She is presently awaiting a major restoration.











Basically, all these vessels represent preservation successes. However, they are substantially different, both in type and condition, from *C.A. THAYER*. The vessel in the closest condition to her at the time she was hauled is the coasting schooner *AUSTRALIA* at Mystic Seaport. She was removed from the water in the early 1960's to be repaired as she was leaking badly. She was partially disassembled with the idea of restoring her but the idea was abandoned. She remained out of the water and began rot rapidly as she dried. Now all that remains is a relic which is housed in a corrugated steel building with a dirt floor which is open to the atmosphere. Visitors can walk through her and see how wooden ships are built. She is not being preserved beyond keeping her inside. She continues to deteriorate although at a slow rate.

There are no major engineering problems associated with putting *C.A. THAYER* in a permanent berth ashore. Essentially, the process is to drydock her atop a flooded barge, then pump out the barge and refloat the *THAYER*/barge combination. A steel cradle is assembled around the vessel, strong enough to support her when she is either skidded or lifted off the barge. The barge is then moved near the permanent site where the vessel, supported by the cradle, is moved onto land. Considering the cost and feasibility alone, the ideal site is one where the barge grounds out so that the bottom of the cradle is level with the skidway. It is possible, but far more difficult, to do a move like this from a floating barge. (The existing Hyde Street Pier is not suitable for this type of operation or supporting this much weight.) If the site is such that the barge can't approach it (the Presidio Army Base has been suggested), the move may have to be preceded by extensive earth moving and dredging. There are a very few huge cranes in the world, used in offshore engineering, that could conceivably be used, but that again depends on the site. Their daily cost is very high. Once the vessel is on its site, the building is erected over it. The cost of a move can only be estimated when the site is identified. Whatever its nature, a move like this will be an expensive and complicated operation. It is also unlikely that a site of any sort can be found next to the San Francisco Maritime NHP.

As far as the ability of *THAYER* to withstand a move to a permanent site on land, it can be managed so that the loads on her will be like those involved in a simple drydocking. That is, a move can be engineered that will cause anxiety, but no structural damage. As she gets more rotten, she will get progressively weaker and less able to withstand the move. Consequently, the supporting cradle will have to be more robust and elaborate.

One of the dangers of moving *C.A. THAYER* ashore is that she may deteriorate even more







rapidly. Putting a wooden ship in a dry berth is not a panacea and the end of all maintenance. People have pointed with alarm to the cases of *WAPAMA* and *CHARLES F. GORDON* both of which deteriorated rapidly after being hauled out due to an acceleration of dry rot and structural changes in the wood due to rapid drying. It's been shown that both of these phenomena can be managed by saturating the timbers with a sodium borate wood preservative and then controlling the rate of drying over an extended period. It's critical to keep the vessel wet after it is hauled until the wood preservation treatment is completed. The use of polyethylene-glycol or some other agent to replace the lost moisture will probably not be necessary to preserve the *THAYER*. This is the expected preservation sequence:

1. Move *C.A. THAYER* to its permanent site. Immediately begin the sodium borate treatment.
2. Erect a permanent building over the vessel. The vessel must be protected from drying excessively while the building is completed.
3. Continue the intensive sodium borate treatment until adequate concentrations have been reached. This process will take years. The vessel will remain closed to the public during this time.
4. Allow the vessel to dry slowly while monitoring any structural changes in the wood.
5. Open the vessel to the public.

It is true that a wooden ship that is merely hauled out on dry land without being preserved, as many ships have been, will deteriorate at a much more rapid rate than if it were left in the water. After the preservation treatment has been completed and *C.A. THAYER* has dried, her rate of decay will be much slower and she will no longer require the annual maintenance required by a floating ship. However, while the maintenance needs will be reduced, they will not disappear.

There have been many suggestions to restore or rebuild *THAYER* with plastics. One is to rebuild wooden structural members with epoxy resins or a combination of epoxy and wood. For example, the HSR (Section 2-6.4.3) shows how the rotten centers of deck beams could be rebuilt by graving in wooden filler pieces - this method does nothing to address the repair of the beam ends which are very rotten. Plainly the deck beams must be removed from the vessel



There have been many suggestions as to why THAYER with glycerol. One is to replace wooden structural members with epoxy resins or a combination of epoxy and wood. For example, the HSM (Section 3-4-43) shows how the inner surface of deck beams could be

replaced by a floating ship. However, while the maintenance needs will be reduced, they will be of heavy will be much slower and the will no longer require the annual maintenance water. After the preservation treatment has been completed and C.A. THAYER has tried, he as many ships have been, will deteriorate at a much more rapid rate than if it were left in the It is true that a wooden ship that is merely hauled out on dry land without being preserved.

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to repair the hull, but because they are fastened to the clamp with steel drifts, it is unlikely that they can be removed in one piece. Conceivably, new beam ends could be patched on to the repaired beam middles and returned to the renewed vessel, but the repair would be weak. Possibly some selected timbers, like hanging knees, could be repaired without extensive work. However, most could not be and would need to be replaced with new timber. The total reconstruction would be piecemeal. Repairs of this nature will undoubtedly show and will not preserve the original patina of the cargo hold. It will take longer and cost more than simply scrapping the piece. The result will be inferior both structurally and esthetically.

One of the more marginal repair ideas is to saturate rotten timbers with epoxy resin. In essence, a thin epoxy resin is applied to the outside of decayed timbers in the hope that it will percolate through the wood before it hardens. The theory is that it will consolidate the rotten wood and fuse it with the good. Many wooden boat owners have repaired small pieces of wood with a popular product called "*Git Rot*" at least to the extent that the wood seems more solid. However, research has shown that partially rotted timbers that have been saturated with epoxy have large localized stresses when exposed to moisture due to the different rates of expansion of the two materials. This method has never been used with success on large timbers and is certainly not useful for something like *THAYER* with so much hidden structure. Even if the resin could be made to go everywhere in the wood before it hardens, it will do little to restore the longitudinal strength of *THAYER*.

Fiber reinforced plastics (FRP) have revolutionized boatbuilding since the late 1950's. In addition to new construction, it's been used with mixed success to repair old wooden boats. It's been suggested that the bottom of *C.A. THAYER* be sheathed with FRP. Such a sheathing would provide a flexible watertight skin that would stop the entry of toredos and the leaching out of borates. It will not add any significant strength and should not be considered as an alternative to rebuilding/replacing weakened structure. All repairs to the bottom planking would require the FRP to be cut and removed from the damaged area. Upon completion of wood repairs, a new FRP patch can be applied.

Applying FRP above the waterline would be a mistake. In wooden hulls, water vapor is constantly passing out through the topside planking. An FRP layer above the waterline will trap this moisture against the wood and promote rot that will be very difficult to detect. Repairs would be impossible without removing the FRP.

The application of FRP to wooden hulls has a long troubled history. Modern adhesives







and techniques should improve on the chances of success. However, FRP has never been applied to a vessel of this size.

### ***Recommendations for Long Term Preservation***

***C.A. THAYER*** should be preserved in the long term either through complete restoration or through controlled preservation in a building ashore. Alternative methods which make extensive use of epoxy resins and reinforced plastics are experimental and should not be used.

In the event ***C.A. THAYER*** is rebuilt, most of the timber will need to be replaced with new. Long lengths of Douglas Fir comparable to the quality of the original can be acquired through special arrangements with the sawmills. Before the wood can be ordered, the NPS, with the help of engineers, must decide on the lengths and grade of wood that will be used. After these decisions about her restoration are made, the wood must be purchased immediately to allow it to dry properly. Before being shaped and installed, the timbers should be preserved from decay and insect attack with a wood preservative. Additional high strength material may be incorporated with and hidden in the restored structure to minimize future structural deformation. The renewed vessel should be ballasted to reduce internal bending forces. In addition, the only suitable way to do a job of this magnitude is all at once, with no interruptions and with a dedicated work force. Following her rebuilding, ***C.A. THAYER*** must have an explicit plan for upkeep and a person responsible for her condition.

***C.A. THAYER*** can be preserved out of the water. Although, her condition is different from other large vessels that have been successfully preserved ashore. The knowledge and techniques to insure preservation exist and have been proven. However, she should not be removed from the water unless the NPS is prepared for the entire preservation process. Removing ***THAYER*** from the water, installing her in her permanent site and preserving her in a building is a major undertaking. Even if the wood preservative treatment were begun when the vessel was afloat, it must continue after the vessel is hauled. The temperature and humidity of the building must be controlled while her wooden structure is preserved and stabilized. This process can be expected to take several years. After this phase is completed, maintenance of the vessel will be minimal. Attempting to store the vessel out of the water without immediately moving her to a permanent site and preserving her is a recipe for failure. Preservation should proceed immediately upon removing the vessel from the water.



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## **REFERENCES**

1. Bray, Maynard, **Mystic Seaport Museum Watercraft**, Mystic Seaport Museum, Mystic, Conn. 1979.
2. Bray, Maynard et aliis, **Taking Care of Wooden Ships**, Maine Seagrant Publications, Walpole, ME, 1978.
3. Carr, D.R., **Boron as a Timber Preservative**, *Wood*, Vol. 23, pp. 380-382, 1958.
4. Curtis, W.H., **The Elements of Wood Ship Construction**, McGraw-Hill Book Co., Inc., New York, NY, 1919.
5. Forest Products Laboratory, **Wood Handbook: Wood as an Engineering Material**, U.S. Dept. of Agriculture, Washington, D.C., 1974.
6. Grove, Scott L., **Treatment of Douglas-Fir Heartwood with Copper Napthanate in AWWA P9 Type A Solvents**, American Wood-Preservers' Association, Annual Meeting, 1989.
7. de Jonge, J.T., **The Efficacy of Boron Treatments**, International Research Group on Wood Preservation, Eighteenth Annual Meeting, May, 1987.
8. Kaiser, F.F., **The Curse of the Hog**, *National Fisherman*, August, 1975.
9. Kavlie, D. and Wierzbicki, T. **Review of USS CONSTITUTION Structural Analysis and Proposal for Strengthening**, Department of the Navy, SUPSHIP BOSTON, Boston, MA, October, 1990.
10. Lebow, S.T. and Morrell, J.J., **Penetration of Boron in Douglas Fir and Western Hemlock**, *Forest Products Journal*, Vol. 39, No. 1, 1989.
11. Lebow, S.T. and Morrell, J.J., **Borate Treatment of Seasoned Western Hemlock and Douglas Fir Lumber**, *Forest Products Journal*, Vol. 41, No. 1, 1991.
12. Levingston, Steve, **Historic Ships of San Francisco**, Chronicle Books, San Francisco, 1984.



# REFERENCES

1. Bray, Maynard, Mythic Forest Materials Laboratory, Maine Seeger's Museum, Maine, Conn. 1972.
2. Bray, Maynard et al., Taking Care of Wooden Ships, Maine Seeger's Publications, Walpole, ME, 1972.
3. Carr, D.R., Boys as Timber Preservers, Wood, Vol. 23, pp. 380-382, 1928.
4. Curtis, W.H., The Elements of Wood Ship Construction, McGraw-Hill Book Co., Inc., New York, NY, 1919.
5. Forest Products Laboratory, Wood Handbook: Wood as an Engineering Material, U.S. Dept. of Agriculture, Washington, D.C., 1974.
6. Grove, Scott L., Treatment of Douglas-Fir Heartwood with Copper Naphthenate in AFTA, FT Type A Solvents, American Wood-Preservers' Association, Annual Meeting, 1932.
7. de Jonge, J.T., The Effect of Boron Treatments, International Research Group on Wood Preservation, Eighteenth Annual Meeting, May, 1937.
8. Kaiser, F.F., The Cause of the Hog, National Fisherman, August, 1932.
9. Kavlie, D. and Wierzbicki, T., Review of 1932 CONSTITUTION Structural Analysis and Proposal for Strengthening, Department of the Navy, SHIP BOSTON, Boston, MA, October, 1930.
10. Lebow, S.T. and Morrell, J.J., Retention of Boron in Douglas Fir and Western Hemlock, Forest Products Journal, Vol. 39, No. 1, 1939.
11. Lebow, S.T. and Morrell, J.J., Retention of Boron in Douglas Fir and Western Hemlock, Forest Products Journal, Vol. 41, No. 1, 1941.
12. Lebow, S.T., Retention of Boron in Douglas Fir and Western Hemlock, Forest Products Journal, Vol. 41, No. 1, 1941.



13. Thornton, J., Preservation of the Warship WASA, Wood, June, 1964.
14. Tri-Coastal Marine, Schooner C.A. THAYER Historic Structure Report, San Francisco Maritime National Historic Park, National Park Service, 1990.
15. Tri-Coastal Marine, Steam Schooner WAPAMA Historic Structure Report, San Francisco Maritime National Historic Park, National Park Service, 1986.
16. Tri-Coastal Marine, Technical Service Report 8902-13 Test Borings for Boron Penetration, San Francisco Maritime National Historic Park, National Park Service, 1989.
17. Trott, Harlan, The Schooner that Came Home, Cornel Maritime Press, Cambridge, Md. 1958.
18. U.S. Borax, Tim-Bor for Wood Preservation, Treatment Manual, U.S. Borax & Chemical Corp., Los Angeles, CA.
19. Witherell, Peter, A Study of Wooden Ship Hogging - The USS CONSTITUTION, Proceedings of the Sixteenth AIAA/SNAME Symposium on the Aero/Hydronautics of Sailing, Vol. 33, October, 1986.
20. Witherell, Peter, Proposal for the FY 92 Drydocking Restricted Availability (DRAV) of USS CONSTITUTION, Puget Sound Naval Shipyard (Detachment, Boston), Boston, MA, February, 1991.



13. Thompson, J. Preservation of the Warship USS A. Wood, June, 1954.
14. The Coastal Marine, Schaefer, C. J. THE MARINE HISTORIC STRUCTURES REPORT, San Francisco Maritime National Historic Park, National Park Service, 1980.
15. The Coastal Marine, Stearns, Robert, THE MARINE HISTORIC STRUCTURES REPORT, San Francisco Maritime National Historic Park, National Park Service, 1985.
16. The Coastal Marine, Technical Services Report 8202-12 Test Results for Borne Preservation, San Francisco Maritime National Historic Park, National Park Service, 1989.
17. Trout, Harlan, The Shipowner that Came Home, Cornell Maritime Press, Cambridge, Md. 1958.
18. U.S. Borne, The Key for Wood Preservation, Treatment Manual, U.S. Borne & Chemical Corp., Los Angeles, CA.
19. Whitwell, Peter, A Study of Wooden Ship Hoses - The USS CONSTITUTION, Proceedings of the Sixteenth ALA/SHAME Symposium on the Art/Hydrography of Sailing, Vol. 33, October, 1985.
20. Whitwell, Peter, Proposal for the FY 92 Restoration Project Available (NAVY) in USS CONSTITUTION Project Second Naval Shipyard (Destruction, Boston), Boston, MA February, 1991.



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## APPENDIX I

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APPENDIX I

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## ***C.A. THAYER* Preservation Committee Meeting**

The Preservation Committee met for the first time on Wednesday and Thursday the 20th and 21st of February, 1991 at the Travelodge at Fisherman's Wharf in San Francisco. The Committee members are specialists in the fields of wooden shipbuilding and ship preservation and come from all over the United States. A list of the Committee members and their addresses is attached to this document. The following National Park Service (NPS) personnel attended all or part of the meeting:

Bill Thomas - Superintendent, San Francisco Maritime National Historic Park (NHP)

Tom Mulhern - Chief of Historic Preservation, Western Region

Mike Bell - Project Manager, NHP

Bill Doll - Curator of Small Craft, NHP

The Committee followed the meeting's agenda. However, the discussion expanded to cover topics not on the agenda but which the Committee believed to be germane to *C.A. THAYER's* problems. Though all the major topics were addressed, the discussion did not necessarily follow the order of the agenda. The Committee put its findings in a series of draft resolutions which are attached. Except where noted, the resolutions were unanimous. As the discussions were to be informal and were tape recorded it was decided that there was no need for formal minutes. The following is intended to convey the sense of the meeting, the background to the resolutions and the main points which weren't specifically covered by the resolutions. The discussion was free ranging and spirited and often returned to issues which had already been commented on at length. For example, Daily Maintenance was covered principally during the Wednesday morning session, but the subject was brought up repeatedly later in the meeting. For clarity, these remarks have been collated into sections which generally follow the meeting agenda.

The Committee discussed its authority, the reason for its existence and the difference between it and previous committees and boards which have met to consider the state of *C.A. THAYER*. Specific reference was made to the 1989 "*C. A. THAYER Preservation Workshop Report*". The members, having reviewed that report, wondered how this meeting would be different. They noted that none of the recommendations of that report seemed to have been followed. There were questions about the Committee's relationship with the NHP and what its duties were. They agreed that, in general, they not specify how work should be done, but that it should be done. The Committee agreed that it should be the precursor to a standing



CA THAYER Preservation Committee Meeting

The Preservation Committee met for the first time on Wednesday and Thursday the 20th and 21st of February, 1991 at the Travelodge at Fisherman's Wharf in San Francisco. The Committee members are specialists in the fields of wooden shipbuilding and ship preservation and come from all over the United States. A list of the Committee members and their addresses is attached to this document. The following National Park Service (NPS) personnel attended all or part of the meeting:

Bill Thomas - Superintendent, San Francisco Maritime National Historic Park (NHP)  
Tom Mulhern - Chief of Historic Preservation, Western Region  
Mike Bell - Project Manager, NHP  
Bill Doll - Curator of Small Craft, NHP

The Committee followed the meeting's agenda. However, the discussion expanded to cover topics not on the agenda but which the Committee believed to be germane to CA THAYER's problems. Though all the major topics were addressed, the discussion did not necessarily follow the order of the agenda. The Committee put its findings in a series of draft resolutions which are attached. Except where noted, the resolutions were unanimous. As the discussions were to be informal and were tape recorded it was decided that there was no need for formal minutes. The following is intended to convey the sense of the meeting, the background to the resolutions and the main points which were specifically covered by the resolutions. The discussion was free ranging and spiraled and often returned to issues which had already been commented on at length. For example, Daily Maintenance was covered principally during the Wednesday morning session, but the subject was brought up repeatedly later in the meeting. For clarity, these remarks have been collated into sections which generally follow the meeting agenda.

The Committee discussed its authority, the reason for its existence and the difference between it and previous committees and boards which have not to consider the state of CA THAYER. Specific reference was made to the 1989 C.A. THAYER Preservation Workshop Report. The members, having reviewed that report, wondered how this meeting would be different. They noted that none of the recommendations of that report seemed to have been followed. There were questions about the Committee's relationship with the NHP and what its duties were. They agreed that, in general, they not specify how work should be done, but that it should be done. The Committee agreed that it should be the precursor to a standing



committee whose principal duty would be to serve as an advisory group to the NHP. They agreed that the standing committee should not meet on an ad hoc basis, but regularly, to review the status of the vessel.

### **DAILY MAINTENANCE**

Regarding Daily Maintenance, there were questions about the physical plant, the number of employees, their duties and the nature of supervision. The Committee, generally expressed consternation about the lack of daily maintenance on all the ships. They inquired about who was responsible for the daily maintenance and what his duties were. There was general agreement that responsibility for the care of the vessels must be clear and there must be accountability for the care of individual ships (Resolutions #1 & #2). They asserted that, at a minimum, the vessels should be kept clean, well ventilated and painted. There were several comments to the effect that in spite of having less money for maintenance, the situation was better under Harry Dring and that most of the problems with daily maintenance could be attributed to lack of leadership at the NHP.

The committee members had all recently inspected the vessel to some degree and having reviewed the Historic Structure Report (1990) agreed that her present condition was generally poor and that this could be attributed mostly to the lack of regular maintenance. The primary cause of the continued rotting of the vessel is caused by the leaking deck. All agreed that some method must be used to keep further water from coming in the deck. The Committee was split on the installation of a cover. There were many objections to the use of a cover. Making the deck water tight by some other means was mentioned. It was generally thought that the deck is so soft and decayed that it can no longer be made tight by caulking the seams.

### **WOOD PRESERVATION**

As far as the treatment of rot, the consensus was that there may be some merit in trying the sodium borate treatment and that it should be implemented, at least on a trial basis, immediately (Resolution #3). However, the Committee agreed that there should be no large scale piping installation like on *WAPAMA*. They mostly agreed that the vessel should not be taken out of service during the treatment and that some passive form of treatment was preferred. They heard about the relative toxicity of the sodium borate and there was the suggestion that *C.A. THAYER* could be surrounded by a vinyl tank during the treatment. However, the committee heard that the sodium borate is not toxic to mammals and although a







small amount might leach through the hull, it is likely that there wouldn't be any insurmountable problems in doing some form of treatment where the vessel is now. The condition of the bottom was believed to be poor, although it was noted that the plywood sheathing (applied in 1979) has been fairly effective in protecting the planking below the waterline from worm damage, it's caused the waterline planking to decay. The condition of the lower framing may be rotted; however survey has shown that this is most likely "soft rot" (anaerobic) and consequently not as disastrous as dry rot. The lower futtocks and floors may be rotted, but the extent to which they are can't be seen until the hull is opened and inspected. Most of the group thought the lowest strake of ceiling should be removed in order to inspect the lower framing and keel (Resolution #10). They also considered removing this piece during their discussion of ventilation aboard *C.A. THAYER*. Everyone agreed that increasing the circulation of air in the frame bays was critical. The generally held idea during the Wednesday and Thursday sessions was that this bilge strake was a light limber strake and could be easily removed. When members of the Committee inspected the vessel in the drydock, they discovered that this strake was a regular ceiling plank. Most of them then reconsidered their idea of removing it.

## RECONSTRUCTION

They discussed at length the condition of the vessel and how it relates to the reconstruction. The consensus was that the deck, topside planking and upper framing are very decayed and probably must be replaced entirely. The extent of decay in the bottom can't be assessed until the vessel is opened for inspection. The Committee questioned Captain Lee extensively about his experiences rebuilding large wooden ships. He said that there was no advantage in retaining the deck during reconstruction - it should be removed to facilitate the rebuilding. The ceiling appeared to be in better condition than the planking and he conceded that perhaps some of it could be saved and that the vessel could be rebuilt from the outside in (the opposite of normal practice); however, he believed that any attempt to repair partially rotted timbers was misguided. In particular, he stated that he didn't think the ceiling planks could be removed without destroying them.

The Committee as a whole discussed the idea of "historic fabric" on which there were two schools of thought. The first argument was that the original materials of the vessel should be preserved and they should be replaced only where they had substantially decayed. This would entail reconstruction of individual members. The alternative, and the prevalent idea, was that the essence of the vessel did not consist of the individual bits of wood; that it was far more



small amount might reach through the hull, it is likely that there wouldn't be any insurmountable problems in doing some form of treatment where the vessel is now. The condition of the bottom was believed to be poor, although it was noted that the plywood sheathing (applied in 1979) has been fairly effective in protecting the planking below the waterline from worm damage, it's caused the waterline planking to decay. The condition of the lower framing may be rotted; however survey has shown that this is most likely "soft rot" (anaerobic) and consequently not as disastrous as dry rot. The lower funnels and floors may be rotted, but the extent to which they are can't be seen until the hull is opened and inspected. Most of the group thought the lowest strake of ceiling should be removed in order to inspect the lower framing and keel (Resolution #10). They also considered removing this piece during their discussion of ventilation aboard C.A. THAYER. Everyone agreed that increasing the circulation of air in the frame bays was critical. The generally held idea during the Wednesday and Thursday sessions was that the big stave was a light timber stave and could be easily removed. When members of the Committee inspected the vessel in the drydock, they discovered that this stave was a regular ceiling plank. Most of them then reconsidered their idea of removing it.

## RECOMMENDATION

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important to rebuild the vessel with the same method and materials as were used by the  
master builder, Bendisner. The idea of rebuilding individual pieces of structure had a largely  
negative response.

The Committee agreed that no form of in the water reconstruction of C.A. THAYER  
should be attempted; that it would surely result in a bad job. They agreed that although the  
vessel could be rebuilt in several stages the result would inevitably be worse and more  
expensive than rebuilding in a single stage. They all agreed that one of the graving docks at  
Hunter's Point would be the most suitable site for the restoration as it already has all the  
repair facilities and areas for material storage (Resolutions #12 & #13). They agreed that the  
present lack of running water, sanitation and electricity were not important and that a  
determined effort should be made to obtain the facility. Rebuilding on a floating drydock or  
barge is possible, though it is not as desirable as working in a graving dock. It was noted that  
the NPS owns a floating drydock that is presently leased to Pacific Drydock in Oakland. The  
Committee repeatedly emphasized the advantages that controlling their own facility would  
have for the NHP in rebuilding C.A. THAYER and maintaining the other vessels. They gave as  
an example, that at present there is only one facility in the Bay that can drydock EUREKA and  
that acquiring the Hunter's Point facility would allow smaller firms, which don't have a large  
enough dock, to bid on the project. It was also pointed out that the commercial yards in the  
area are presently incapable of doing the work correctly.

## RESTORATION ALTERNATIVES

Concerning alternatives to full restoration of C.A. THAYER, the Committee strongly  
agreed that there is no desirable alternative; in spite of that they did briefly discuss several of  
them. The only one that was not dismissed out of hand was the display of the vessel on dry  
land. They said that putting the vessel on land without cover is the worst possible alternative.  
To illustrate this they gave the examples of WAPAMA and CHARLES F. GORDON which  
both deteriorated rapidly when they were hauled on land. It was pointed out that GORDON  
was very similar to C.A. THAYER but younger and in better condition when she was hauled. It  
was mentioned that the rot of the topside proceeds just as rapidly in a dry berthed vessel.  
However, it was said that there is the advantage to having a vessel on dry land in that the  
underwater sections are accessible. The point was made that the historic structure should  
remain in its historic setting which in the case of a ship may mean the water.

The agenda listed various topics necessary for further negotiations for future work. The



Committee addressed all of these in a general way. They were told that the NPS has had difficulties in the past with work orders. The consensus was that it's almost impossible to write a contract to restore any part of *C.A. THAYER* as she's nearly unique. Some members said that it would be very difficult to get a meaningful bid for this work out of local yards as they are extremely unfamiliar with this type of work. The Committee discussed the duties of an "owner's" representative to supervise repairs in a ship yard (Resolution #11). It was noted that the NPS has had many bad experiences with local repair yards. Further, it is quite possible that these yards may go out of business. All these are reasons why the Committee strongly urged the NPS to get its own ship repair facility.

As far as finding the manpower and materials necessary for the rebuilding of *C.A. THAYER*, the Committee stated that both were available. They suggested several small firms which specialize in wooden ship construction, travel around the country and are capable of doing the work. They heard about the long length of some of the timbers in the vessel and stated that they were available. They said that special arrangements must be made with the loggers and the mills to get these long lengths and that generally that must be done when the trees are still standing. The repeatedly stressed and often returned to the importance of making a timber list now and buying the larger timbers well in advance of the actual reconstruction (Resolutions #7 & #8). Committee members mentioned the names of defunct repair yards where most of the fastenings could be obtained.

The Committee discussed at length issues which were not on their agenda, but which they felt were directly related to the preservation of *C.A. THAYER*. They cited the previous lack of success in maintaining *C.A. THAYER* and other vessels. The consensus was that if *C.A. THAYER* were to be rebuilt, some sort of agency independent from the NPS had to be formed (Resolutions #5 & #6). Some expressed doubts about the compatibility of this type of project with the federal employment and contractual systems. They questioned the NPS personnel about the total budget and the monies available for routine and cyclical maintenance. Several committee members believed that the money was not being well used. It was also suggested that if the budget were not sufficient to preserve the present tonnage of ships, that the NPS consider de-accessioning one or more of the vessels.

#### **INSPECTION OF *C.A. THAYER* AND HUNTER'S POINT DRYDOCK**

The meeting reconvened Friday, the 22nd at Pacific Drydock Co. in Oakland where *C.A. THAYER* was hauled. In the dry dock the Committee had the opportunity to inspect the hull



Committee addressed all of these in a general way. They were told that the NPS has had difficulties in the past with work orders. The consensus was that it's almost impossible to write a contract to restore any part of C.A. THAYER as she's nearly unique. Some members said that it would be very difficult to get a meaningful bid for this work out of local yards as they are extremely unfamiliar with this type of work. The Committee discussed the duties of an "owner's" representative to supervise repairs in a shipyard (Resolution #11). It was noted that the NPS has had many past experiences with local repair yards. Further, it is quite possible that these yards may go out of business. All these are reasons why the Committee strongly urged the NPS to get its own ship repair facility.

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#### PRESENTER OF C.A. THAYER AND HISTORICAL BACKGROUND

The meeting adjourned Friday, the 22nd at Pacific Drydock Co. in Oakland where C.A. THAYER was hauled. In the dry dock the Committee had the opportunity to inspect the hull



and was generally dismayed about the condition of certain parts of it. The Committee recommended to the NPS people who were present, that portions of the port side planking just above the current waterline be immediately replaced. On Friday afternoon, the Committee traveled to the Hunter's Point Naval Shipyard where they inspected the facilities. They agreed that graving dock and the adjacent woodworking facility would be ideal for the repair of C.A. *THAYER* and other vessels in the NHP.



and was generally dismayed about the condition of certain parts of it. The Committee recommended to the NPS people who were present that portions of the boat side planking just above the current waterline be immediately replaced. On Friday afternoon, the Committee traveled to the Hunter's Point Naval Shipyard where they inspected the facilities. They agreed that graving dock and the adjacent woodworking facility would be ideal for the repair of C.A. THAYER and other vessels in the NHP.



**Resolution #1:**

To have a contract let to prepare a written instruction for routine maintenance of the C.A. THAYER, in three months and have that ready for the next meeting of this group.

**Comment:**

Mr. Bray made the motion. The idea is to have a document that the Marine Maintenance Foreman, deck hands and riggers can follow for day-to-day, week-to-week, month-to-month and year-to-year maintenance. Maynard felt that a good starting place was to use his manual "Taking Care of Wooden Ships", and tailoring it to suit the Maritime Museum ships individually.

**Additional Comments:**

HH: *"The intent of this resolution was to provide guidelines only, and not to require, as doctrine, that the items listed must be followed to the letter. There are some things which ought to be rigidly followed on a daily basis, including weekends and holidays such as bilge soundings, and routine under deck visual inspections of all accessible compartments. Other recommendations should be listed as resolved above, but only with the intent to provide a guide to the new Marine Superintendent, who will doubtless have his own style of operation when he takes charge. This assures that the new Mar. Supt. is hired because he is qualified, on the basis of experience, to establish his own routine for maintenance and operation of each ship in the museum fleet. Resolutions provided by this Committee should be offered as guidelines with some emphasis on mandatory items to be done no matter who takes charge."*

FF: *"This is a good place to start. The written routine maintenance instructions should provide that the workers involved can and must be willing and able to do any or all of the duties as outlined in the instructions."*

*At this time some thought should be given to a plan for regular periodic applications of the sodium borate solution to certain parts and areas of the schooner. This will be dealt with in more detail under Resolution #3."*

JE: *"There is, of course, definite need for a daily work program which would spell out specific tasks. Don Birkholz is well qualified to get up such a program due to his past history of in-depth association with the vessel. It is my opinion that he be asked to prepare the program"*



To have a contract let to prepare a written instruction for routine maintenance of the C-4  
 TWAY, in three months and have that ready for the next meeting of this group.

Comment:

Mr. Bry made the motion. The idea is to have a document that the Marine Maintenance  
 Foreman, deck hands and riggers can follow for day-to-day, week-to-week, month-to-month  
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Additional Comment:

HH: "The intent of this resolution was to provide guidelines only, and not to require as doctrine  
 that the items listed must be followed to the letter. There are some things which ought to be  
 highly followed on a daily basis, including weekends and holidays such as oiling, scrubbing,  
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 regular boat solution to certain parts and areas of the schooner. This will be dealt with in  
 more detail under Resolution #3.

JE: "There is of course definite need for a daily work program which would spell out specific  
 tasks. Don Bishop is well qualified to get up such a program due to his past history of in-  
 depth cooperation with the vessel. It is my opinion that he be asked to prepare the program."





*and hopefully be able to initially keep an eye on work program until such time the work force can continue with the normal daily supervision."*

**D&L/L:** *"We strongly recommend that Mr. Birkholz be picked for this particular job. It came up more than once during the committee meeting."*



and hopefully be able to finally keep an eye on work progress until such time the work force can continue with the normal help operation.

D&L: "We strongly recommend that Mr. Barker be picked for this particular job. It came up more than once during the committee meeting."



Resolution #2:

Shipkeeper be assigned to the C.A. THAYER.

Comment:

There were some reservations about having any personnel assigned to one specific ship.

Additional Comments:

MB: *"We voted on this, I believe, overriding objections raised by Karl and maybe someone else. I still think it's a good idea, and if a revote is needed, I'll cast mine as affirmative."*

DB: *"I recall that only Mr. Kortum objected to this recommendation."*

HH: *"There aren't enough people in the ship maintenance crew to enjoy the luxury of one man per ship as a permanent or scheduled practice. The authority of the Marine Superintendent should cover this subject of daily routine inspections. The Mar. Supt. is by definition and job description, responsible for all the ships. He will, or should assign individuals to each ship, depending upon the daily rounds required for routine surveillance. Any maintenance work should be assigned by Mar. Supt. on project basis and assigning required numbers of persons to do the work."*

*Essentially most of the work to be done on all the museum ships is repair and maintenance . thus, the skills of the entire work force should be focused on that work. Presumably, the work force will be hired as individuals on the basis of their skills, i.e., carpentry, electrical, rigging, metal work including welding, etc."*

FF: *"It might be desirable at times to assign a competent person as a shipkeeper. This situation is related to Resolution #1."*

JE: *"I think that it would be desirable to appoint one person to be responsible for work aboard C.A. THAYER at least during the start of a new work program. Past history indicates that too many people were involved in maintenance with no one person with enough authority to follow through with regular work programs. It is important that one person be involved on a daily basis and be directly involved with each detail of ongoing work. Once a proper*



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Additional Comments:

MR: "We voted on this. I believe, overriding objections raised by kind and maybe someone else. I will think it's a good idea and if a vote is needed, I'll cast mine as affirmative."

DR: "I recall that only Mr. Korman objected to this recommendation."

HR: "There aren't enough people in the ship maintenance crew to enjoy the luxury of one man per ship as a permanent or scheduled practice. The authority of the Marine Superintendent should cover this subject of daily routine inspection. The Mar. Sup. is by definition and job description responsible for all the ship. He will or should assign individuals to each ship, depending upon the daily routine required for routine surveillance. Any maintenance work should be assigned by Mar. Sup. on project basis and assigning required number of persons to do the work."

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FR: "It might be desirable at times to assign a competent person as a shipkeeper. This situation is related to Resolution 4.1."

DR: "I think that it would be desirable to appoint one person to be responsible for work aboard C.A. THAYER at least during the start of a new work program. Past history indicates that too many people were involved in maintenance with no one person with enough authority to follow through with regular work program. It is important that one person be involved on a daily basis and be directly involved with each detail of ongoing work. Once a proper



*maintenance schedule is established and a work force can carry on without supervision every hour of every day, then maybe a maintenance manager-type person could then spend more time with other ships and their needs. The key to good workmanship and a steady performance schedule demands good and regular supervision. It would be difficult to get good results without a supervisor who could devote at least some time each day in order to keep on top of work progress and the need to keep materials and services available when needed."*

D&L/L: *"We felt that this was a good idea. All the vessels in the Museum should have individual shipkeepers who develop a strong sense of pride in their vessel."*



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DAL: "We felt that this was a good idea. All the vessels in the Museum should have individual shipkeepers who develop a strong sense of pride in their vessel."



**Resolution #3:**

That borate preservative treatment be started up on the C.A. THAYER along the lines of recommendations given in the C. A. THAYER historic structure report with the run-off possibly being drained or pumped into the city sewer system. The borate treatment should not be in lieu of other wood preservative measures.

**Comment:**

This motion was recommended by Karl Kortum and seconded by Doug Lee. The general feeling is that this work can begin immediately based upon the experience with the WAPAMA and the availability of the sodium borate.

**Additional Comments:**

MB: *"I seem to remember we discussed using borate as one would use salt as a preservative, i.e., a passive rather than active system. But if we voted as above, I have no objection."*

FF: *"As the C.A. THAYER now lays at her berth, two categories of destructive processes are taking place, ROT and HOG - probably at a rate that is near exponential. As the rot progresses the ability of the schooner to resist hogging diminishes. The forces that produce hogging are ever present and unrelenting. During the time period while funding for more permanent restoration is procured (three years?) and to make possible the retention of a reasonable amount of her present structure (fabric), these steps must be taken now..."*

- A. *Put the schooner through an intensive sodium borate saturation treatment for a limited period of time during which it is not open to the public. At this time a semi-permanent piping system should be installed to distribute the borate solution into each frame bay between the ceiling and the outside planking, under the sole in the forecastle area, in the chain locker and in certain areas under the poop deck and aft cabin. This semi-permanent system should be left in place when the schooner is open for exhibit and used periodically during times closed to the public. The weather decks should never be hosed down with water, fresh or salt while on exhibit. A vigorous sweeping or a sougying (sic) off with deck brush and a bucket of Borax solution should be enough, though requiring more effort.*



That borate preservative treatment be started up on the C.A. THAYER along the lines of recommendations given in the C.A. THAYER historic structure report with the run-off possibly being drained or pumped into the city sewer system. The borate treatment should not be in lieu of other wood preservative measures.

Comment

This motion was recommended by Karl Kortum and seconded by Doug Lee. The general feeling is that this work can begin immediately based upon the experience with the WAPANA and the availability of the sodium borate.

Additional Comment

MEM: I seem to remember we discussed using borate as one would use salt as a preservative, but a preservative rather than active system. But if we voted as above, I have no objection.

FF: "As the C.A. THAYER now lies at her berth, two categories of destructive processes are taking place, ROT and HOG - probably at a rate that is near exponential. As the rot progresses the ability of the schooner to resist hogging diminishes. The forces that produce hogging are ever present and worsening. During the time period while funding for some permanent restoration is procured (three years?) and to make possible the retention of a reasonable amount of her present structure (fabric), these steps must be taken now...

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*During the intensive saturation period, the hold area should be sprayed as the WAPAMA was. This should be done at least once each year. The borate will migrate toward the bottom of damp rotted areas during periods when the solution is not being applied. If a pollution problem develops relative to the possible loss of some of the borate solution outboard of the schooner, this can be solved with a vinyl fabric tank surrounding the hull and attached to a flexible floating containment boom.*

*B. In reference to the hog that is present in the WAWONA now and how those dynamic forces causing it might be countered, these measures were discussed:*

- 1. Ballast placed midship in the hold. This would be effective but would put the vessel deeper in the water and subject the hull to probably destructive stresses.*
- 2. A keel girder of a depth to be effective, either steel or stressed concrete, would probably require dredging of the schooner's present berth. Presently, problems might be encountered when fastening the girder through the deteriorated keelson and riders. This girder should be given serious consideration and requires thorough design engineering, sometime during the schooner's reconstruction, a keel girder should be installed.*
- 3. During the C.A. THAYER workshop meetings Jan. 5th and 6th, 1989, mention of buoyancy tanks or chambers was made in reference to countering the weight in the ends of the schooner against the greater buoyancy of the midship sections.*

*There are available various makes of very heavy duty reinforced rubber bags that are used to transport various materials such as dry cement and liquids. They are also used as air bags to lift or raise sunken vessels. Two or more of these bags can be joined with nylon straps in a way that, if placed thusly at each end of the THAYER's keel, (it) will offset the forces tending to cause hogging. The positive buoyancy of these bags can be calculated to offset or exceed (if thought desirable) the excessive weight in the vessel's ends.*

*It is recommended that this be given serious consideration."*



During the intensive maintenance period, the hold area should be sprayed at the WAPAMA way. This should be done at least once each year. The bottom will migrate toward the bottom of deep rotting areas during periods when the solution is not being applied. If a pollution problem develops relative to the possible loss of some of the bottom solution outboard of the schooner, this can be solved with a vinyl fabric tank surrounding the hull and attached to a flexible floating containment boom.

B. In reference to the hog that is present in the WAWONA now and how those dynamic forces coming it might be countered, these measures were discussed:

1. Ballast placed midship in the hold. This would be effective but would put the vessel deeper in the water and subject the hull to probably destructive stresses.
2. A keel girder of a depth to be effective, either steel or stressed concrete, would probably require dredging of the schooner's present berth. Presently, problems might be encountered when fastening the girder through the structural keelson and ribs. This girder should be given serious consideration and require thorough design engineering sometime during the schooner's reconstruction, a keel girder should be installed.

3. During the C.A. THAYER workshop meetings Jan. 25th and 26th, 1989, mention of buoyancy tanks or chambers was made in reference to counteracting the weight in the ends of the schooner against the greater buoyancy of the midship section.

There are available various makes of very heavy duty reinforced rubber bags that are used to transport various materials such as dry cement and liquids. They are also used as air bags to lift or raise sunken vessels. Two or more of these bags can be joined with nylon straps in a way that, if placed thrush in each end of the THAYER's keel, (ii) will offset the forces tending to cause hogging. The buoyancy of these bags can be calculated to offset or exceed (if thought desirable) the excessive weight in the vessel's ends.

It is recommended that this be given serious consideration.



JE: *"This preservation treatment seems to be working for WAPAMA and should be an aid in keeping C.A. THAYER alive. At the very least, the borate treatment should be started on a trial basis and be set up in an area where its affect can be readily monitored. If the treatment proves to be doing a good job then a more comprehensive installation can be worked out."*



100

101 The preservation treatment seems to be working for WABAMA and should be an aid in  
keeping C.A. THAYER alive. At the very least the house treatment should be tested on a  
trial basis and be set up in an area where its effect can be readily monitored. If the treatment  
proves to be doing a good job then a more comprehensive installation can be worked out.



**Resolution #4:**

Insofar as possible, this group recommends that the *C.A. THAYER*, in due course, be restored with the same materials, configuration, standards of workmanship as original, and further, that the original fabric be retained wherever possible consistent with the foregoing.

**Comment:**

Harold Huycke made the original motion. The concern was whether to preserve the original fabric by gluing the ceiling facing on new wood and retain, what Mr. Kortum sees as, one of the "great rooms of America". Dana Hewson suggested replacing any bad wood with new wood as was done on the *CHARLES W. MORGAN*.

**Additional Comments:**

HH: *"The basic principle of retaining as much of original wood as possible, in any restoration work should be strongly underscored, not including rot or obviously deteriorated wood which serves no purpose to retain. Concur 99% with Kortum's general philosophy of retention of original structure wherever feasible. Laminates should be avoided. It will be necessary, however, to accept shorter lengths in certain segments of replacements of beams, frames, covering boards, planks, ceiling planking, etc., due to the local nature of repairs and the dwindling supply of long-length and high grade of lumber in the 1990's. Extra efforts should be made to obtain wood supplies, including knees, wherever possible."*

FF: *"I agree with this to the extent that it is possible. It is probable that some of the ceiling, due to extensive rot, must be replaced full thickness, particularly under the forecastle sole. The ceiling should be repaired by routing out the rot on the outboard face and the wood replaced with laminations as outlined in my letter of May 22, 1989. If the ceiling is edge fastened with steel drifts it may be necessary to crop out the rot between the drifts, insert graving pieces and cover with laminate."*

*Any new wood used to replace old must be pressure-treated. The wood available now is much inferior to that available when the schooner was built. With a saw mill on site and large trees nearby, the builder could choose the very best in the largest sizes needed. If untreated it is unlikely that any wood now available would last half as long. Treatment should be done after shaping. The Chemonite treatment is said to be the most penetrating of*



Insofar as possible, the group recommends that the CA THAYER, in the course, be restored with the same materials, configurations, standards of workmanship as original, and further, that the original fabric be retained wherever possible consistent with the foregoing.

Comments

Harold Huxley made the original motion. The concern was whether to preserve the original fabric by gluing the ceiling facing on new wood and retain what Mr. Kortum sees as one of the "great rooms of America". Dana Hewson suggested replacing any bad wood with new wood as was done on the CHARLES W. MORGAN.

Additional Comments

1811: The basic principle of retaining as much of original wood as possible, in any restoration work should be strongly reinforced, not including rot or obviously deteriorated wood which serves no purpose to retain. Canon 99% with Kortum's general philosophy of retention of original structure wherever feasible. Laminates should be avoided. It will be necessary, however, to accept shorter lengths in certain segments of replacement of beams, frames, covering boards, planks, ceiling planking, etc., due to the local nature of repairs and the deteriorating supply of long-length and high grade of lumber in the 1960's. Extra effort should be made to obtain wood supplies, including knees wherever possible.

1812: I agree with this to the extent that it is possible. It is probable that some of the ceiling, due to extensive rot, must be replaced full thickness, particularly under the forecastle sole. The ceiling should be repaired by running out the rot on the outboard face and the wood replaced with laminations as outlined in my letter of May 22, 1968. If the ceiling is edge jointed with steel strips it may be necessary to crop out the rot between the strips, using grouting pieces and cover with laminates.

Any new wood used to replace old must be pressure-treated. The wood available now is much inferior to that available when the schooner was built. With a new mill on the site and large tract nearby, the builder could choose the very best in the largest sizes needed. If untreated it is unlikely that any wood now available would last half as long. Treatment should be done after shaping. The Casco Bay treatment is said to be the most penetrating of



*the aqueous solutions as applied to Douglas Fir. The color of Chemonite treated wood (light tan or brown) would blend somewhat with the existing timbers as now seen inside the hold. The masts installed in the WAWONA in the early 1970's were pressure-treated with Chemonite after all shaping."*

JE: *"Any serious restoration work will require some, if not all, new lumber to be used in regaining strength in the vessel. Practically all replacement or reinforcing of present wood members consists of structural members rather than trim or decorative items. These structural members are, for the most part, too far gone to be of value as strength members. It is important that all structural parts of the vessel be of good enough quality to be fully functional. There is nothing wrong with using new materials as long as the original scantlings and fastening materials are used in the restoration. The loss of patina will in most cases be brought back with time and spectator traffic. It would be next to impossible to re-use the ceiling members and main deck beams, etc., because of the damage from advanced rot. Any original members of the vessel that are to be salvaged must be free of any serious rot or these members will eventually be the cause of continuing rot that will transfer to other wood members despite preservation treatments such as the borate plan."*

D&L/L: *"It should be realized that the preservation of the ceiling is only a portion of the overall rebuilding."*



the exterior surface as applied to Douglas Fir. The color of Chemtulle treated wood (light tan or brown) would blend harmoniously with the existing timber as now seen inside the hold. The mast installed in the WAWONA in the early 1930's was pressure-treated with Chemtulle after all shoring.

1B: "Any serious restoration work will require some, if not all, new lumber to be used in regaining strength in the vessel. Practically all replacement or reinforcing of pressure wood members consists of structural members rather than trim or decorative items. These structural members are, for the most part, too far gone to be of value as strength members. It is important that all structural parts of the vessel be of good enough quality to be fully functional. There is nothing wrong with using new materials as long as the original scantlings and fastening materials are used in the restoration. The loss of paint will in most cases be brought back with time and spectator traffic. It would be next to impossible to repair the ceiling members and main deck beams, etc., because of the damage from advanced rot. Any original members of the vessel that are to be salvaged must be free of any rot or other wood members will eventually be the cause of continuing rot that will transfer to other wood members despite preservation treatments such as the borate plan."

1C: "It should be realized that the preservation of the ceiling is only a portion of the overall rebuilding."



Resolution #5:

**C. A. THAYER PRESERVATION COMMITTEE**

While formulating Doug Lee's resolution about the clerk of the works, Mr. Kortum brought up the question as to what the group should be called. Mr. Huycke suggested shortening the name to C.A. THAYER Preservation Technical Review Committee. After several people gave their suggestions, Mr. Huycke recommended C.A. THAYER Preservation Committee. Mr. Kortum concurred, and Mr. Doll approved.

Comments:

MB: *"Reword as a resolution (if indeed it was one): that the name of this committee be "The C.A. THAYER PRESERVATION COMMITTEE."*

DB: *"Write out resolution in total."*

HH: *"This will suffice until the Nat'l Park Service states its intention to expand the service of this Committee to include all the historic ships in the Museum fleet, including BALCLUTHA, WAPAMA, EUREKA, ALMA, EPPLETON HALL, C.A. THAYER, HERCULES and possibly in the future, the JEREMIAH O'BRIEN. In which case the Committee should then be re-constituted to include a wider representation of industry personnel who have had experience in maintaining larger steel steamships."*

*Suggest then: Historic Ships Preservation Board, etc.*

*As it is, the name implies only the C.A. THAYER is under review and surveillance, which already is not the case."*



# C. A. THAYER PRESERVATION COMMITTEE

While formulating Doug Lee's resolution about the state of the work, Mr. Kortum brought up the question as to what the group should be called. Mr. Huycke suggested shortening the name to C.A. THAYER Preservation Technical Review Committee. After several people gave their suggestions, Mr. Huycke recommended C.A. THAYER Preservation Committee. Mr. Kortum concurred, and Mr. Doll approved.

## Comments:

MR: "Resolved as a resolution (if indeed it was one); that the name of this committee be 'The C.A. THAYER PRESERVATION COMMITTEE'."

DR: "Write out resolution in total."

MR: "This will suffice until the West Park Service states its intention to expand the service of the Committee to include all the historic ships in the museum fleet, including BALCLUTHA, WATAMA, EUREKA, ALMA, EPPLETON HALL, C.A. THAYER, HERCULES and possibly in the future, the JEREMIAH O'BRIEN. In which case the Committee should then be re-constituted to include a wider representation of industry personnel who have had experience in maintaining larger steel steamships."

Suggest then: Historic Ship Preservation Board, etc.

As it is, the name implies only the C.A. THAYER is under review and surveillance, which already is not the case."



**Resolution #6:**

That the "powers that be" engage the services of a qualified Project Manager, experienced and competent in large wooden shipbuilding practices. This person to be in complete charge of the restoration of the C.A. THAYER, this person shall be accountable to the C.A. THAYER Preservation Committee, and that the position description shall be determined and approved by the Preservation Committee which shall also play an active and appropriate role in the hiring process.

**Comment:**

This resolution was originally proposed by Mr. Lee as part of the "Clerk of the Works" discussion. This resolution is the result of an hour's discussion of proposed responsibilities of the Project Manager.

**Additional Comments:**

DB: "Suggest rewriting last sentence to read:

'The committee shall assist in assessing the qualifications of persons considered for this position'."

HH: "If the C.A. THAYER is to be singled out as the primary and most urgent restoration project out of the entire fleet of museum ships, then a qualified Project Manager should be appointed for this single project, and known to the Preservation Committee. I would not agree that the Project Manager should be 'accountable' to the Committee, however, because this implies an unknown degree of liability on the part of the Committee. The Committee (or Board) should be clearly advisory, only, and not be obligated to burden itself with liability insurance (as would be a Board of Directors, or Trustees). The Project Manager presumably would be a paid employee, by contract or by salary, to the National Park Service, and accountable directly to the Superintendent of the National Maritime Museum fleet, much as any other employee on the pier would be. However, the point should be made that the Project Manager would be approved by or appointed by the Board (Committee) with the Superintendent's approval and thereafter guided and advised by the Board with high degree of emphasis."



That the "power that be" engage the services of a qualified Project Manager, experienced and competent in large wooden shipbuilding practices. This person to be in complete charge of the restoration of the C.A. THAYER, this person shall be accountable to the C.A. THAYER Preservation Committee, and that the position description shall be determined and approved by the Preservation Committee which shall also play an active and appropriate role in the hiring process.

Comment:

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Additional Comments:

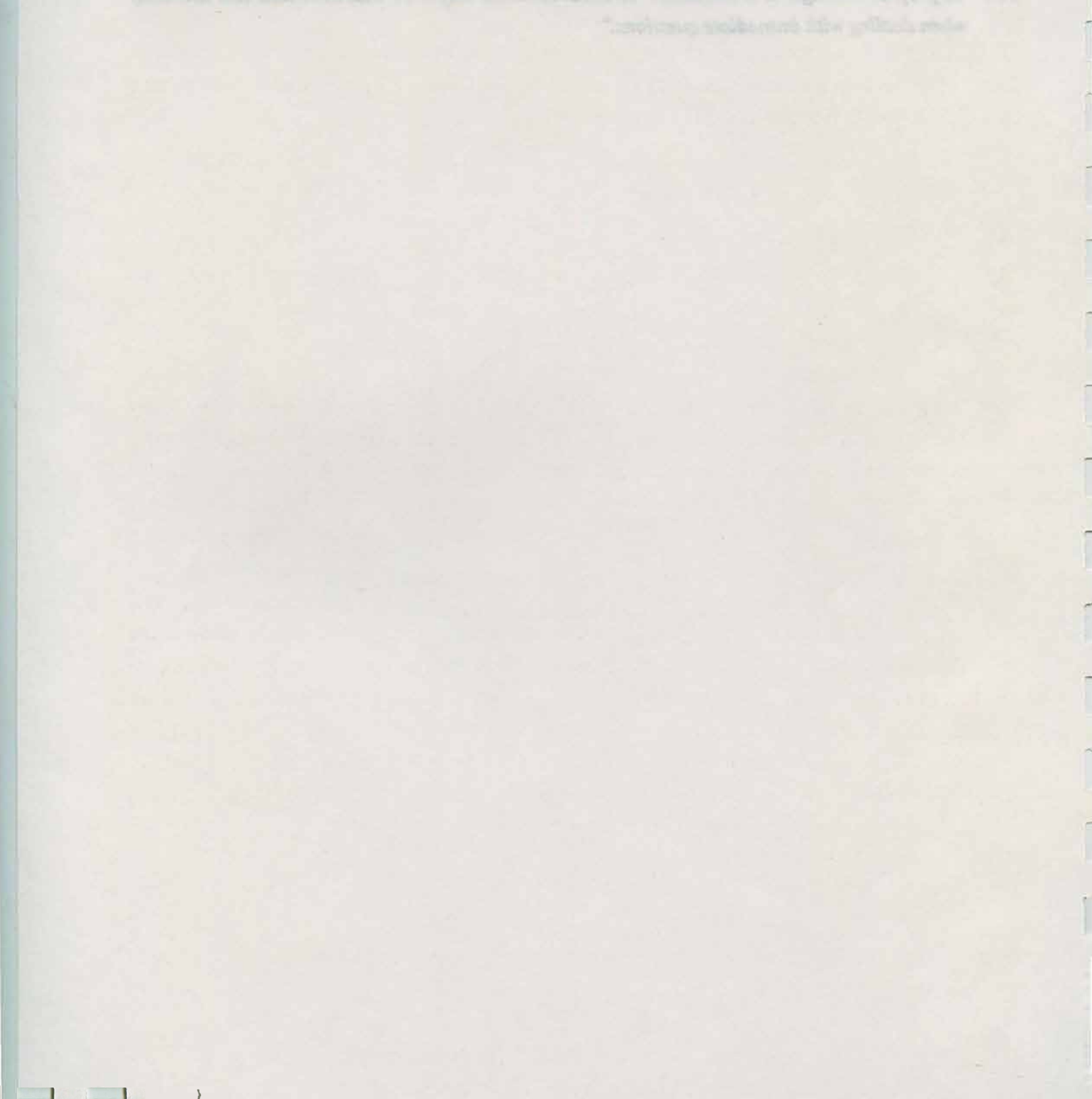
DR: "Suggest rewriting last sentence to read:  
The committee shall assist in assessing the qualifications of persons considered for this position."

HR: "The C.A. THAYER is to be singled out as the primary and most urgent restoration project out of the entire fleet of museum ships, then a qualified Project Manager should be appointed for this single project, and known to the Preservation Committee. I would not agree that the Project Manager should be 'accountable' to the Committee; however, because this implies an unknown degree of liability on the part of the Committee. The Committee (or Board) should be clearly advisory only, and not be obligated to burden itself with liability insurance (as would be a Board of Directors or Trustees). The Project Manager presumably would be a paid employee, by contract or by salary, to the National Park Service, and accountable directly to the Superintendent of the National Maritime Museum fleet, much as any other employee on the pier would be. However, the point should be made that the Project Manager would be approved by or appointed by the Board (Committee) with the Superintendent's approval and oversight and advised by the Board with high degree of emphasis."



FF: *"A project manager is a necessity. A subcommittee might be desirable and less unwieldy when dealing with immediate questions."*







Resolution #7:

That Tri-Coastal Marine or an equivalent organization, as approved by the Preservation Committee develop a detailed list of material, especially wood, as quickly as possible, for the complete restoration of the C.A. THAYER.

Comment:

This resolution was proposed by Mr. Bray wherein he stated, *"The very first thing to do is to make a material list and buy the material."*

Additional Comments:

HH: *"If there is no conflict of interest, and there should be none, Tri-Coastal Marine has already been deeply involved with the C.A. THAYER restoration. I underscore the need for an early start in determining the large needs of all the historic ships, C.A. THAYER especially, but not limited to that ship. The inventory of lumber including materials for planking, but including frames, covering boards, clamps, and large dimensional wood should be acquired. To make this a matter of urgent record, one year is required to make such an inventory ready for use. This includes a winter cut of the trees, so that all sap is down; milling to rough and largest dimension, and shipping to a store house in the San Francisco Bay area where it can then be properly air-dried for at least six months, with continuous monitoring for checks, rot and moisture content. It is conceivable that sources of supply in Washington, Oregon, California, and the Southeastern states of the USA may have to be searched for the best grade of such planks and timbers and shipped to San Francisco. Besides the employment of Tri-Coastal Marine in San Francisco, other parties including members of the Restoration Board may be employed in this nationwide search for materials."*

FF: *"An obvious start depending on funding."*

KK: *"This sounds as if we were in doubt about their competency. I think this impression should be corrected."*

D&L/L: *"Hopefully, Tri-Coastal's past work will have considerable weight on this matter. Why switch now. Special attention should be directed towards funding."*



That the Coastal Marine or an equivalent organization, as approved by the Preservation Committee develop a detailed list of materials, especially wood, as quickly as possible, for the complete restoration of the CA THAYER.

Comment:

This resolution was proposed by Mr. Gray wherein he stated, "The very first thing to do is to make a material list and buy the material."

Additional Comments:

HR: "If there is no conflict of interest, and there should be none, the Coastal Marine has already been deeply involved with the CA THAYER restoration. I understand the need for an early start in determining the type needs of all the historic ships. CA THAYER especially, but not limited to that ship. The inventory of lumber including materials for planking, but including frames, covering boards, clamps, and large dimensional wood should be acquired. To make this a matter of urgent record, one year is required to make such an inventory ready for use. This includes a winter cut of the trees so that all sap is down; milling to rough and rough dimension, and shipping to a store house in the San Francisco Bay area where it can then be properly air-dried for at least six months, with continuous monitoring for check, rot and moisture content. It is conceivable that sources of supply in Washington, Oregon, California, and the Southeastern States of the USA may have to be searched for the best grade of such planks and timbers and shipped to San Francisco. Besides the employment of the Coastal Marine in San Francisco, other parties including members of the Restoration Board may be employed in this nationwide search for materials."

FF: "An obvious start depending on funding."

HR: "This sounds as if we were in doubt about their competence. I think this impression should be corrected."

DR: "Hopefully the Coastal's past work will have considerable weight on this matter. If not, special attention should be directed towards funding."



Resolution No. 7

That procurement of long lead material, especially wood, for the complete restoration of the C.A. THAYER commence as soon as possible.

Comment:

This resolution was proposed by Mr. Bray as a follow-on to the resolution regarding the materials list.

Additional Comment:

DR: "Suggest rewriting to read:  
The procurement of those materials for C.A. THAYER's restoration that will have a long lead time for delivery of cutting, particularly wood, should commence as soon as possible."

HBT: See Resolution No. 7

At an addendum to the wood materials, a general review of metals and other building materials must be reviewed, such as chain rope, tree-nails (if utilized) galvanized or bronze steel, and the suppliers of same must be located as to quantity, quality and reliability."

FP: "Right on."

D&L/L: "Yes. What's the latest word on the Navy graving docks at Hunter's Point? This might have a close tie-in with material procured."



**Resolution #9:**

That suitable funding be secured.

**Comment:**

This was the fourth motion submitted by Mr. Bray and voted on without any specific discussion.

**Additional Comments:**

DB: *"We need to elaborate - does this mean suitable funding to complete the resolution of C.A.T., or for maintenance of the fleet as a whole?"*

HH: *"'Suitable' funding must be narrowed to specifics, which will require different priorities. Buying large quantities of lumber well in advance (see Res. #7, #8 above) will necessitate expenditures more than a year before major restoration can begin on any of the ships in a large scale."*

FF: *"Bear down on the politicians."*

D&L/L: *"Yes. We were led to believe from Mr. Kortum's comment that funding would be no problem. Is this really true? We did not discuss this fully with any of the experts. We have doubts."*



Resolution 18

That suitable funding be secured.

Comment

This was the fourth motion submitted by Mr. Bray and voted on without any specific discussion.

Additional Comments

DB: "He need to elaborate - does this mean suitable funding to complete the resolution of C.A.T. or for maintenance of the fleet as a whole?"

HB: "Suitable' funding must be narrowed to specific, which will require different priorities. Buying large quantities of lumber well in advance (see Res. 47, 48 above) will necessitate expenditures more than a year before major restoration can begin on any of the ships in a large scale."

FP: "Bear down on the politicians."

DEL/A: "Yes. We were led to believe from Mr. Kortum's comment that funding would be no problem. Is this really true? We did not discuss this fully with any of the experts. We have doubts."



**Resolution #10:**

That the strakes of ceiling adjacent to the keelson, port and starboard, be removed for cleaning, survey and ventilation, to help keep the bilges and frame bays dry to prevent further deterioration of the floors, ceiling, frames and keelson.

**Comment:**

This resolution was the consensus of the group with some reservations expressed by Messrs. Kortum, Huycke and Fisher. Mr. Kortum was concerned about the strength that this part of the ceiling added to the weakened vessel. Mr. Huycke suggested removing 20 foot sections. Mr. Fisher suggested boring holes through this lowermost strake of ceiling which would enable someone to reach into each frame bay.

**Additional Comments:**

MB: *"I don't know how to feel about this now after having looked more closely at the vessel. It is a full-thickness ceiling plank and appears to be original in spite of what most of us - in our wisdom - thought. Maybe Karl is right after all. But it sure would be good to know at this time what the condition of the floors, planking, etc., hidden from view might be. We'll have to get access to that area eventually. It would be good to decide upon the ideal way to get that access, and if, as I suspect, it will be from inside instead of outside. Perhaps we have no choice but to sacrifice their patinae strakes. (The garboards and broad strakes - a part of the planking - may be edge fastened, making their removal especially difficult. And, chances are their condition is OK."*

DB: *"This finally resolved (on the drydock floor) to removing alternating sections (spans of about 7 frames each) at the ceiling strake - Kortum agreed to this."*

HH: *"The emphasis should be made that very slow and exploratory work should be done in this regard so that structural weakness will not result from impetuous removals. The recommendation made by me that alternate sections, say 20' long be taken each side so that some segments remain in an alternate pattern on each side of the keelson. There must be random short sections of the lower ceiling plank removed directly opposite each other so that the structure of the frames and floors, and limbers can be examined and learned before more large scale removals are done."*



That the strikes of ceiling adjacent to the kitchen, port and starboard, be removed for cleaning, survey and ventilation, to help keep the bilges and frame bays dry to prevent further deterioration of the floor, ceiling, frames and keelson.

Comments

This resolution was the consensus of the group with some reservations expressed by Messrs. Kortum, Huycke and Fisher. Mr. Kortum was concerned about the strength that this part of the ceiling added to the weakened vessel. Mr. Huycke suggested removing 20 foot sections. Mr. Fisher suggested boring holes through the lowest strike of ceiling which would enable someone to reach into each frame bay.

Additional Comments

HB: "I don't know how to feel about this now after having looked more closely at the vessel. It is a full-thickness ceiling panel, and appears to be original in spite of what most of us - in our wisdom - thought. Maybe that is right after all. But it sure would be good to know at this time what the condition of the floor, planking, etc., hidden from view might be. We'll have to get access to that area eventually. It would be good to decide upon the ideal way to get that access, and if, as I suspect, it will be from inside instead of outside. Perhaps we have no choice but to sacrifice their paintwork strikes. (The gunports and bowal strikes - a part of the planking - may be edge fastened, making their removal especially difficult. And, chances are their condition is OK."

DB: "This finally resolved (on the dykback floor) to removing alternating sections (span of about 7 frames each) at the ceiling strike - Kortum agreed to this."

HB: "The emphasis should be made that very slow and exploratory work should be done in this regard so that structural weakness will not result from impetuous removals. The recommendation made by me that alternate sections up 30' long be taken each side so that some segments remain in an alternate pattern on each side of the keelson. There must be caution about sections of the lower ceiling plank removed directly opposite each other so that the structure of the frames and floors, and timbers can be examined and learned before more large scale removals are done."



FF: *"Hand holes preferred."*

JE: *"For purposes of cleaning, inspection and repair, it is essential that the bilge ceiling strakes be removed in their entirety. These members can no longer be regarded as adding much strength to the vessel. Stiffness in this part of the vessel depends on the frames and keelsons. And certainly, with the vessel no longer employed as a cargo-carrying ship, she will not be subjected to any serious strains and especially so if she is restored. This part of the ceiling is not normally considered to be a big part of the vessel's longitudinal strength and it is recommended that the removal be on a permanent basis which (will) allow for future cleaning and inspection of the vessel's interior backbone."*

D&L/L: *"After examining the schooner in drydock on Friday, February 22, 1991, the committee talked informally about removing alternate 3' strakes from back side. The bilge strakes were in fact heavy structural ceiling timbers - not light removable bilge strakes as we had thought during committee meetings."*

*The thwartship floor boards were also discussed at the drydock as the outboard each of these are retaining moisture which is rotting the ceiling under these ends."*



11: "For purposes of cleaning inspection and repair, it is essential that the bilge ceiling be removed in their entirety. These members can no longer be regarded as adding much strength to the vessel. Suffering in this part of the vessel depends on the frames and keelsons. And certainly, with the vessel no longer employed as a cargo-carrying ship, she will not be subjected to any serious strains and especially so if she is removed. This part of the ceiling is not normally considered to be a big part of the vessel's longitudinal strength and it is recommended that the removal be on a permanent basis which (will) allow for future cleaning and inspection of the vessel's interior bottoms."

D&L/JL: "After examining the schooner in drydock on Friday, February 22, 1991, the committee talked informally about removing members 3, strakes from back side. The bilge strakes were in fact heavy structural ceiling members - not light nonstructural bilge strakes as we had thought during committee meetings."

The liveaboard floor boards were also discussed at the drydock on the weekend each of these and remaining moisture which is rotting the ceiling under these ends."



**Resolution #11:**

That a qualified and capable owner's representative be in attendance at all times whenever the THAYER is being worked on at a commercial shipyard. If necessary, such expertise should be retained from outside the Park Service.

**Comment:**

This resolution followed the discussion on the removal of the bilge strake. Mr. Birkholz felt that an owner's representative be always present at the shipyard because it was felt that the shipyards tend to treat the Park Service as an "easy mark" for change orders because of poorly written specifications and (shipyards) usually do not have the skilled labor necessary to work on wooden ships without good guidance from an owner's representative.

**Additional Comments:**

HH: *"The Nat'l Park Service is vulnerable on this point because of a lack of supervision and experience in restoration or repair of large wooden ships. Underscore the recommendation that an Owner's representative not only be in attendance during the removals of any segments of the basic structure, but also during any hull repairs in the shipyard. The Owner's Representative should be an employee of the Nat'l Park Service, but barring the availability of a qualified ship-wright in the Park Service employ, an outside party should be employed in lieu thereof. In this case, Jack Ehrhorn would be the most qualified member of the Restoration Board, and he is a shipwright by trade."*

FF: *"See Resolution #6."*

JE: *"This is an important recommendation that should receive utmost consideration."*

D&L/L: *"After our observation at the drydock. It is obvious that this person should have an active role in writing the contract. The present "contract writer" at the Museum appears to be part of the problem not the solution!"*



That a qualified and capable owner's representative be in attendance at all times whenever the THAYER is being worked on at a commercial shipyard. If necessary, such expertise should be retained from outside the Park Service.

Comment:

This resolution followed the discussion on the removal of the bilge snake. Mr. Birkholz felt that an owner's representative be always present at the shipyard because it was felt that the shipyard tend to treat the Park Service as an "easy mark" for change orders because of poorly written specifications and (shipyard) usually do not have the skilled labor necessary to work on wooden ships without good guidance from an owner's representative.

Additional Comments:

Mr. The Navy Park Service is vulnerable on this point because of a lack of supervision and experience in restoration or repair of large wooden ships. Under score the recommendation that an Owner's representative not only be in attendance during the removal of any segments of the basic structure, but also during any hull repairs in the shipyard. The Owner's Representative should be an employee of the Navy Park Service, but having the availability of a qualified shipwright in the Park Service employ, an outside party should be employed in lieu thereof. In this case, Jack Etkin would be the most qualified member of the Restoration Board, and he is a shipwright by trade.

PT: "See Resolution #6."

IT: "This is an important recommendation that should receive serious consideration."

DAJL: "After our observation at the drydock, it is obvious that this person should have an active role in writing the contract. The present 'contract writer' at the Museum appears to be part of the problem not the solution."



**Resolution #12:**

That the National Park Service should secure a permanent location for the on-going care of its fleet. This should include a suitable graving dock or dry dock. Once secured, the site should be developed and staffed to ensure the future care of the fleet. This facility will need to have a realistic funding level established which will enable this work to be accomplished.

**Comment:**

This motion, proposed by Dana Hewson, was meant to supersede Resolution #9. An important part of the discussion was Mr. Huycke's view that if there was a facility to work specifically on the Maritime Museum's ships, the Navy's wooden mine sweepers would also use this same facility because this would have the qualified and skilled labor to do the most cost effective job.

**Additional Comments:**

HH: *"This resolution can only bring to a focus of attention the dearth of shipyard facilities in the entire San Francisco Bay area, including Oakland-Alameda, Mare Island Vallejo and any or all yards in the San Joaquin-Sacramento Rivers, where shipyards used to exist. The biggest difficulty in finding shipyards and drydocks is caused by the extra large bulk of the EUREKA with her wide beam. The Oakland Drydock cannot lift this ship. Only the larger drydock at So. San Francisco (Southwest Marine) or a graving dock at Hunter's Point can do so. And with the graving dock/drydock must go the machine and wood-working shops with an adequate and experienced team of wood shipwrights, a combination which does not exist at either shipyard.*

*I am approaching the U.S. Navy, Mine Group One, Seattle, with the initial proposition that the Navy has a vested interest in this problem as well as the Nat'l Park Service."*

FF: *"This may be an overly optimistic goal. If work for the U.S. Navy is taken on, it would likely involve performance bonding and other technical requirements not needed for a special purpose facility. A second choice to Hunter's Point would be a barge alongside a dock or other area where material and machinery could be placed."*



That the National Park Service should secure a permanent location for the on-going care of its fleet. This should include a suitable graving dock or dry dock. Once secured, the site should be developed and staffed to ensure the future care of the fleet. This facility will need to have a realistic funding level established which will enable this work to be accomplished.

Comments

This motion, proposed by Dana Hawron, was meant to supersede Resolution 99. An important part of the discussion was Mr. Huxley's view that if there was a facility to work specifically on the Maritime Museum's ships, the Navy's wooden mine sweepers would also use this same facility because this would have the qualified and skilled labor to do the most cost effective job.

Additional Comments

111: "This resolution can only bring to a focus of attention the death of shipyard facilities in the San Francisco Bay area including Oakland-Alameda, Mare Island Vallejo and any in all points in the San Joaquin-Sacramento Rivers, where shipyards used to exist. The biggest difficulty in finding shipyards and drydocks is caused by the extra large bulk of the ELBERTA. The Oakland Drydock cannot lift this ship. Only the larger drydock at San Francisco (Southwest Marine) or a graving dock at Hunter's Point can do so. And with the graving dock/drydock must go the machine and wood-working shops with an adequate and experienced team of wood shipwright, a combination which does not exist at either shipyard."

I am approaching the U.S. Navy Mine Group One Section with the initial proposition that the Navy has a vested interest in this problem as well as the NPS Service."

112: "This may be an overly optimistic goal. If work for the U.S. Navy is taken on, it would likely involve performance bonding and other technical requirements not needed for a special program facility. A second choice to Hunter's Point would be a large aluminum dock or other area where material and machinery could be placed."





D&L/L: *"The Museum should forge ahead on its own rather than trying to get tied up with the Navy. That dubious partnership could lead to endless complications."*



1971

DALLAS The Museum should judge about on its own rather than trying to get tied up with the  
Navy. This dubious partnership could lead to endless complications.



Resolution #13:

That one or two of the graving docks at Hunter's Point be procured for the Maritime Museum's use in the upcoming *EUREKA* caulking job, and be available afterwards for further historic ship upkeep and restoration in the future years. This to be done in view of the diminishing availability of drydocking facilities and the inability of the existing yards to undertake the kind of work needed.

Comment:

The resolution was proposed by Doug Lee and seconded by Mr. Huycke. This resolution was suggested after Mr. Mulhern's discussion on the topic of the operation and funding of the Parks Service. It was pointed out by Mr. Mulhern that there was an ancient piece of legislation which would allow the Secretary of Interior to request assistance from the Secretary of Defense, and it was felt that this would be the vehicle to acquire the Hunter's Point graving dock and facility.

A very important point made by Mr. Mulhern was that the title to the historic ships at the Maritime Museum and title to the Navy's mine sweepers are not held by the Parks Service or the U.S. Navy; both are held by the United States of America. The Parks Service is simply an administrative agency just as the Navy is.

Additional Comments:

MB: "Could this also be combined with #12?"

DB: "This is actually a companion resolution to #12. Suggest rewriting Para. 3 to make more sense. (If you are to use this comment in a final draft.)."

HH: "(See Res. #12 above) One of the most important facts which the Nat'l Park Service faces, which the Navy is not plagued with, is simply this: The Museum ships (all seven of them) cannot be removed from San Francisco Bay because of their ages and generally overall weakened condition. They can be towed, cautiously, to sheltered waters within the confines of San Francisco Bay. Whereas the Navy has two ocean-going minesweepers USS EXCEL and USS GALANT, each can proceed under its own power for Puget Sound, Los Angeles or San Diego for drydocking unless there is serious underwater damage to the hull which



That one or two of the graving docks at Hunter's Point be procured for the Maritime Museum's use in the upcoming EXPO '86, and be available afterwards for further historic ship upkeep and restoration in the future years. This to be done in view of the diminishing availability of drydocking facilities and the inability of the existing yards to undertake the kind of work needed.

Comment:

The resolution was proposed by Doug Lee and seconded by Mr. Hayek. This resolution was suggested after Mr. Mulhern's discussion on the topic of the operation and funding of the Parks Service. It was pointed out by Mr. Mulhern that there was an ancient piece of legislation which would allow the Secretary of Interior to request assistance from the Secretary of Defense, and it was felt that this would be the vehicle to acquire the Hunter's Point graving dock and facility.

A very important point made by Mr. Mulhern was that the title to the historic ships at the Maritime Museum and title to the Navy's mine sweepers are not held by the Parks Service or the U.S. Navy; both are held by the United States of America. The Parks Service is simply an administrative agency just as the Navy is.

Additional Comments:

MR: "Could this also be combined with #12?"

DB: "This is actually a companion resolution to #12. Suggest rewriting Para. 3 to make more sense. (If you are to use this comment as a final draft)."

HH: "(See Res #12 above) One of the most important facts which the Port Park Service faces which the Navy is not plagued with is simply this: The Museum ships (all seven of them) cannot be removed from San Francisco Bay because of their size and generally overall poor condition. They can be towed, certainly, to sheltered waters within the confines of San Francisco Bay. Whereas the Navy has two categories: USS EXOCT and USS GALANT, each can proceed under its own power for Puget Sound, Los Angeles or San Diego for drydocking unless there is serious underwater damage to the hull which



*precludes this move.*

*Inasmuch as the Navy is running into perceived hostile attitudes from the City of San Francisco and is reducing its presence in San Francisco (as well as SF Bay), it is quite probable that the two remaining minesweepers will be moved to San Diego or Puget Sound for permanent station."*

FF: "Good idea."

D&L/L: "Mr. Mulhern's comments were of great value. We believe that he should receive this report directly when it is finished. There may be some value in naming Mr. Mulhern to our committee."



much as the move  
inasmuch as the Navy is running into serious trouble from the City of San  
Francisco and is reducing its presence in San Francisco (as well as SF Bay) it is quite  
probable that the two remaining newspapers will be moved to San Diego or Puget Sound  
for permanent station."

FF: "Good idea."

D&L: "Mr. Mulheim's comments were of great value. We believe that he should receive this  
report directly when it is finished. There may be some value in naming Mr. Mulheim to our  
committee."



**Resolution #14:**

This group recognizes and appreciates the excellent work done by Tri-Coastal Marine, and in particular by Don Birkholz, and recommends that the National Park Service continue a relationship for contracted services with Tri-Coastal so the vessels continue to benefit from the knowledge, experience and expertise that has been developed by Don Birkholz over time.

**Comment:**

This motion was presented by John Carter, along with his statement that the C.A. THAYER Preservation Committee is tremendously impressed by the knowledge, the dedication and work that has been done by Tri-Coastal Marine, particularly Don Birkholz. Mr. Lee seconded the motion and stated that it may not be possible in this day and age for a federal agency to operate the museum and that the work that has been done by Tri-Coastal has been accomplished in a just and fair manner as the federal guidelines dictate. Mr. Birkholz felt that it was a conflict of interest, since he sat on the committee, for him to vote. Mr. Kortum suggested that Mr. Birkholz not vote on this motion. Linda Lee felt that for anyone else to get "up to speed" would take three or four years.

**Additional Comments:**

DB: "Aw shucks, guys..."

HH: *"I strongly concur with the resolution that as long as Don Birkholz and 'Tri-Coastal Marine' are willing to continue with its corporate services as a marine surveying firm, consultant and also as a member of this C.A. THAYER Preservation Committee that no objections be raised nor obstructions to such an arrangement be accepted. The prior reports and detailed study and survey of the C.A. THAYER in particular and the other historic ships has required a lot of time and a lot of knowledge-gathering work. Familiarity is a definite asset for all concerned. Any 'conflicts of interest' which may arise with Birkholz on the Restoration Committee can be, and should be properly addressed and solved so that no parties are seen to be prejudiced.*

*It must be recognized that there are very few, if any existent corporate entities in the United States which are endowed with the historic knowledge of the individual ships in question which in turn requires a knowledge of old shipbuilding practices and related materials. It*



This group recognizes and appreciates the excellent work done by T&E Coastal Studies, and in particular by Don Bishop, and recommends that the National Park Service continue a relationship for contracted services with T&E Coastal as the vessel continues to benefit from the knowledge, experience and expertise that has been developed by Don Bishop over time.

**Comments:**

This motion was presented by John Carter, along with his statement that the C.A. THAYER Preservation Committee is tremendously impressed by the knowledge, the dedication and work that has been done by T&E Coastal Studies, particularly Don Bishop. Mr. Lee seconded the motion and stated that it may not be possible in this day and age for a federal agency to operate the museum and that the work that has been done by T&E Coastal has been accomplished in a just and fair manner at the lowest possible cost. Mr. Bishop felt that it was a matter of interest since he sat on the committee, for him to vote. Mr. Korman suggested that Mr. Bishop say one or two words. Linda Lee felt that for anyone who is not up to speed, would take three or four years.

**Adjourned Comments:**

DB: "New sheet, page."

HR: "I strongly agree with the resolution that is being at Don Bishop and T&E Coastal Studies, and willing to continue with its response service as a member surveying firm, continuing and also as a member of the C.A. THAYER Preservation Committee that no objection be raised nor intention to make an amendment be proposed. The prior report and detailed study and survey of the C.A. THAYER is particularly and the other historic ship has required a lot of time and a lot of knowledge/expertise work. Furthermore it is difficult even for all concerned, and 'conflict of interest' which may arise with Bishop on the Resolution Committee can be and should be properly addressed and noted so that no conflict arises in the proposed."

It must be recognized that there are very few if any other responses coming in the United States and that the National Park Service is the only one that is in a position to do this.



*would be costly in time and money to re-train people and corporate entities to learn and practice the needs of historic ships."*

FF: *"Right on."*

JE: *"The opportunity to use the services of Tri-Coastal Marine, and in particular the services of Mr. Don Birkholz should be given high priority."*



would be costly in time and money to re-train people and corporate entities to learn and practice the needs of historic ships.

FF: "Right on."

JE: "The opportunity to use the services of Tidewater Marine and in particular the services of Mr. Don Burkholder should be given high priority."





## **PARTICIPANTS AT C. A. THAYER BOARD OF SURVEY**

Mr. Don Birkholz  
Tri-Coastal Marine, Inc.  
200 Burrows Street  
San Francisco, CA 94134

Mr. Maynard Bray  
Neskeag Road  
Brooklin, ME 04616  
(207) 359-8593

Mr. John Carter  
321 Chestnut Street  
Philadelphia, PA 19106  
(215) 925-5439

Mr. Jack Ehrhorn  
117 Iron Road  
Alameda, CA 94501  
(415) 523-3030

Mr. Fred Fisher  
3100 Fuhrman Avenue East  
Seattle, WA 98102  
(206) 323-3077

Mr. Dana Hewson  
Mystic Seaport Museum  
Grenmanville Avenue  
Mystic, CT 06355  
(203) 572-0711

Capt. Harold D. Huycke  
18223 - 84th Place West  
Edmonds, WA 98020  
(206) 774-7574 (H)  
(206) 774-1444 (O)

Mr. Karl Kortum  
San Francisco Maritime NHP  
Building 204, Fort Mason  
San Francisco, California 94123

Mr. & Mrs. Doug Lee  
P. O. Box 482  
Rockland, ME 04841  
(207) 594-8007

Mr. Harold Sommer  
P. O. Box 343  
Sausalito, CA 94965  
(415) 332-4996





## APPENDIX II





APPENDIX II





### **List of Builders**

All these firms have been either prime subcontractors or labor subcontractors on the building or repair of historic wooden ships. These firms all relocate to the site.

Allen C. Rawl, Inc.  
Allen Rawl, President  
11314 Reynolds Road  
Bradshaw, MD 21021  
(301) 592-2170

Bay Ship and Yacht Co.  
William Elliott, General Manager  
P.O. Box 4104  
Dept. 142  
Alameda, CA 94501  
(415) 898-6445

North Atlantic Shipbuilding and Repair  
Dave Short, President  
RR#1 Box 1915  
Freedom, ME 04941  
(207) 589-4207

Richardson Bay Boatbuilders  
P.O. Box 1575  
Sausalito, CA 94966  
(415) 331-0742



List of Builders

All these firms have been either prime subcontractors or labor subcontractors on the building or repair of historic wooden ships. These firms all relocate to the site.

Allen C. Rawl, Inc.  
Allen Rawl, President  
11314 Reynolds Road  
Bridgetown, MD 21021  
(301) 292-2170

Ray Ship and Yacht Co.  
William Elliott, General Manager  
P.O. Box 4104  
Dept. 142  
Alameda, CA 94501  
(415) 292-6442

North Atlantic Shipbuilding and Repair  
Dave Short, President  
Rt. 1 Box 1915  
Freedom, ME 04941  
(207) 589-4207

Richardson Bay Boatbuilders  
P.O. Box 1272  
San Rafael, CA 94965  
(415) 331-0742





### Wood Toxicologists

Wood toxicologists who have consulted on the preservation of the *C.A. THAYER*.

Dr. Jeff Morrell (503-737-4222)  
Forest Products Laboratory  
Oregon State University  
Corvallis, OR

Dr. John Shelley (415-231-9547)  
Forest Products Laboratory  
U.C. Berkeley Richmond Field Station  
Richmond, CA



Wood Toxicologists

Wood toxicologists who have consulted on the preservation of the CA THAYER.

Dr. Jeff Montell (503-737-4323)  
Forest Products Laboratory  
Oregon State University  
Corvallis, OR

Dr. John Shelley (415-231-9247)  
Forest Products Laboratory  
U.C. Berkeley Richmond Field Station  
Richmond, CA





### **APPENDIX III**



APPENDIX III



### Longitudinal Loading Curves

The longitudinal bending moment is a measure of the forces that are making C.A. *THAYER* hog. It is the smooth, solid line of these curves. For the present loading condition (no ballast), the maximum bending moment amidships is about 2500 ft.- tons. The other loading curves show that the bending moment could be reduced or made zero amidships by the addition of ballast or buoyancy. The jagged shear curve shows the change of loading along the length.

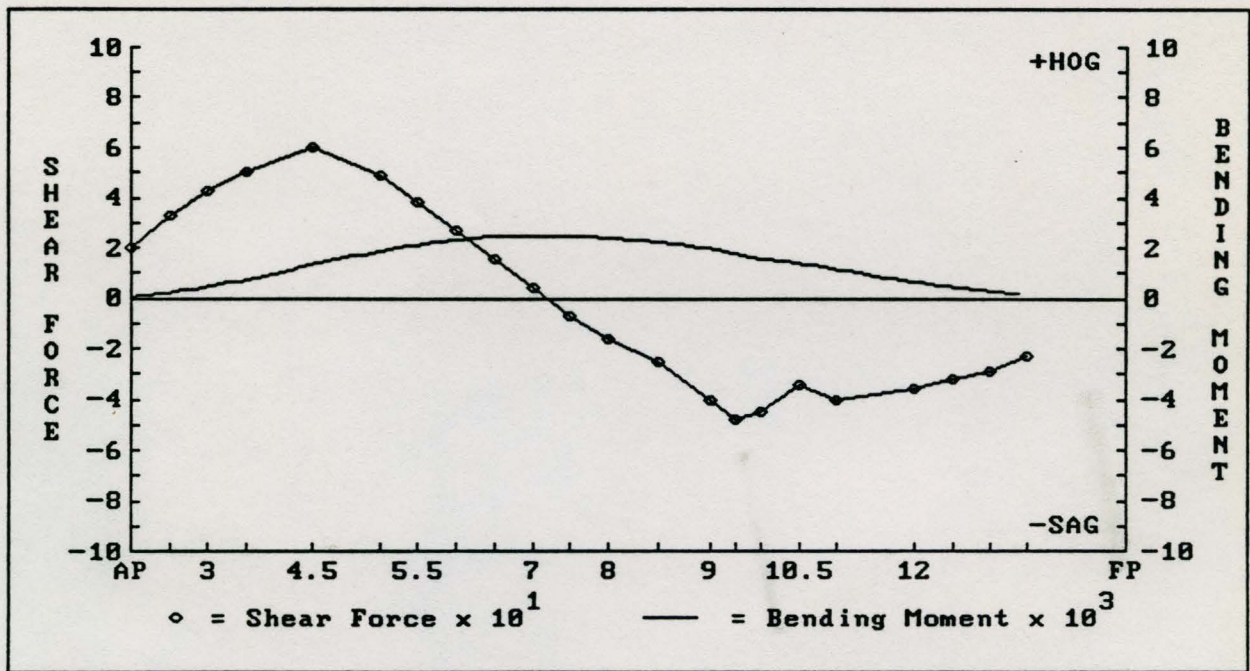


### Longitudinal Loading Curves

The longitudinal bending moment is a measure of the forces that are making C.A. WATER hog. It is the smooth solid line of these curves. For the present loading condition (no ballast), the maximum bending moment amidships is about 2500 ft.-tons. The other loading curves show that the bending moment could be reduced or made zero amidships by the addition of ballast or buoyancy. The jagged shear curve shows the change of loading along the length.

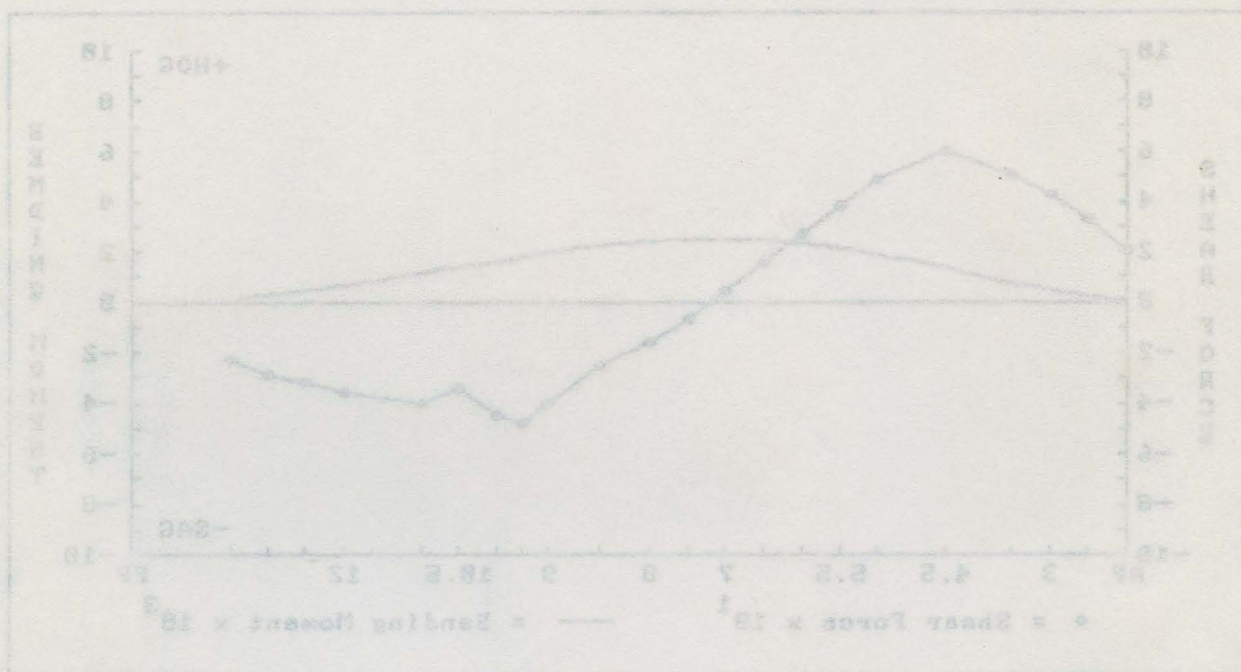


# Present Longitudinal Loading





# Present Longitudinal Loading







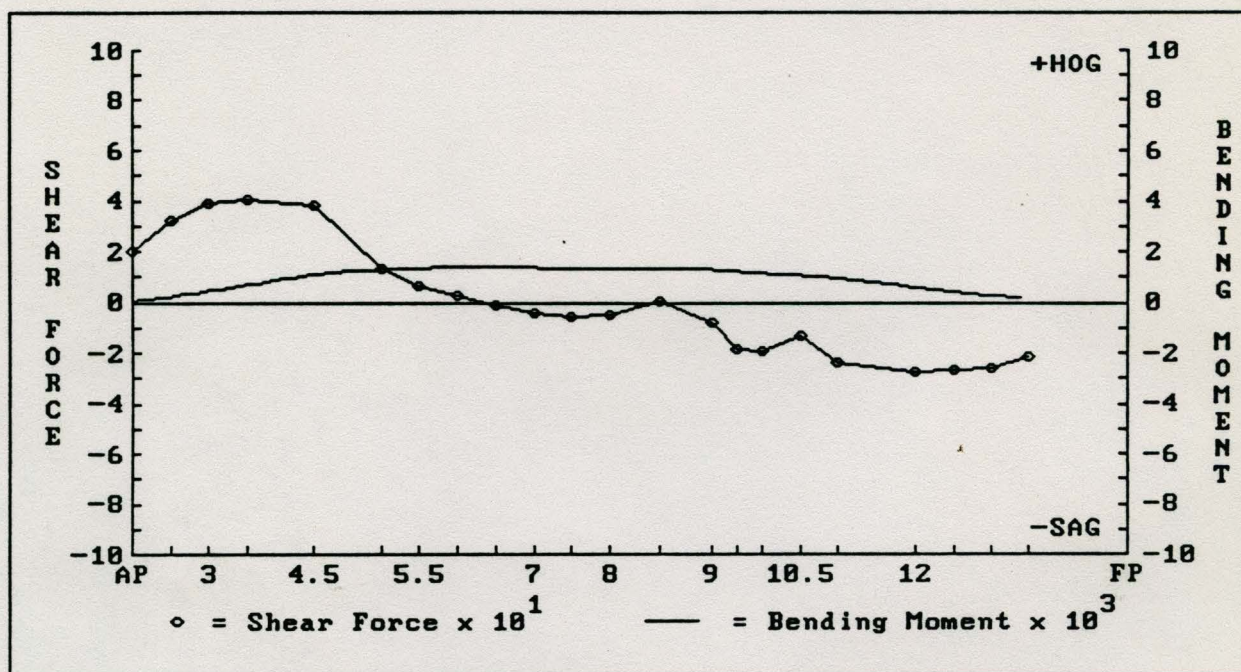
#### APPENDIX IV



APPENDIX IV

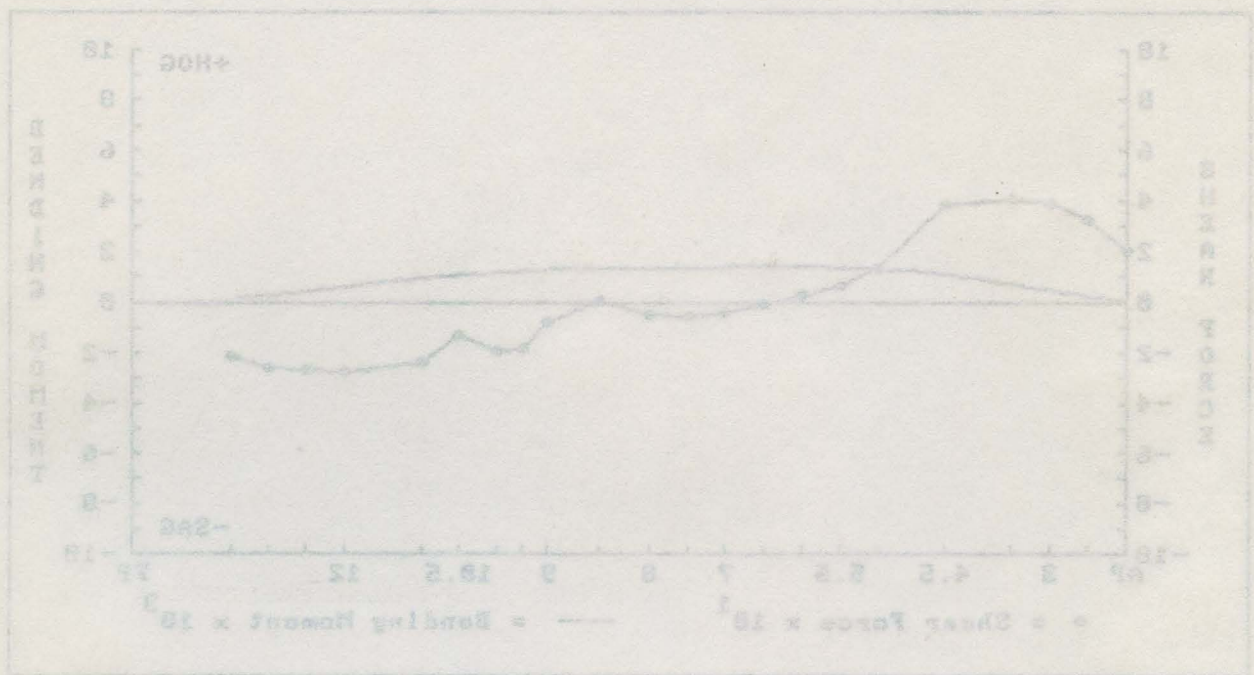


# 125 L. Tons of Ballast Added Amidships



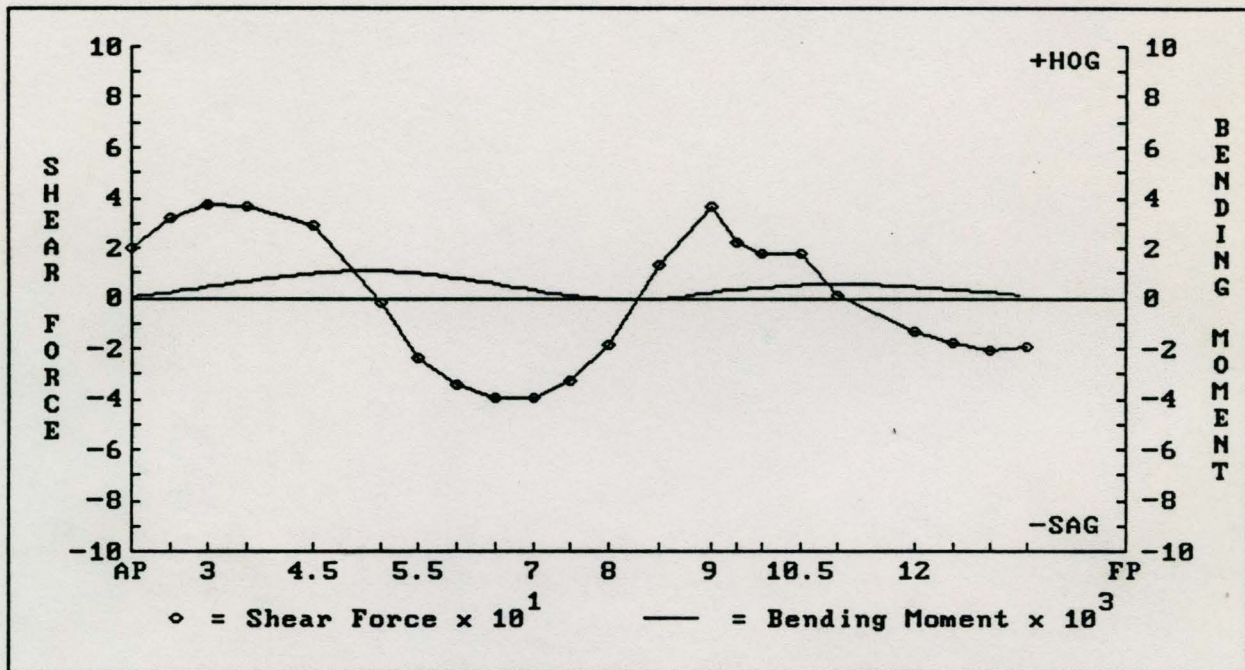


# 125 Tons of Ballast Added Amidships



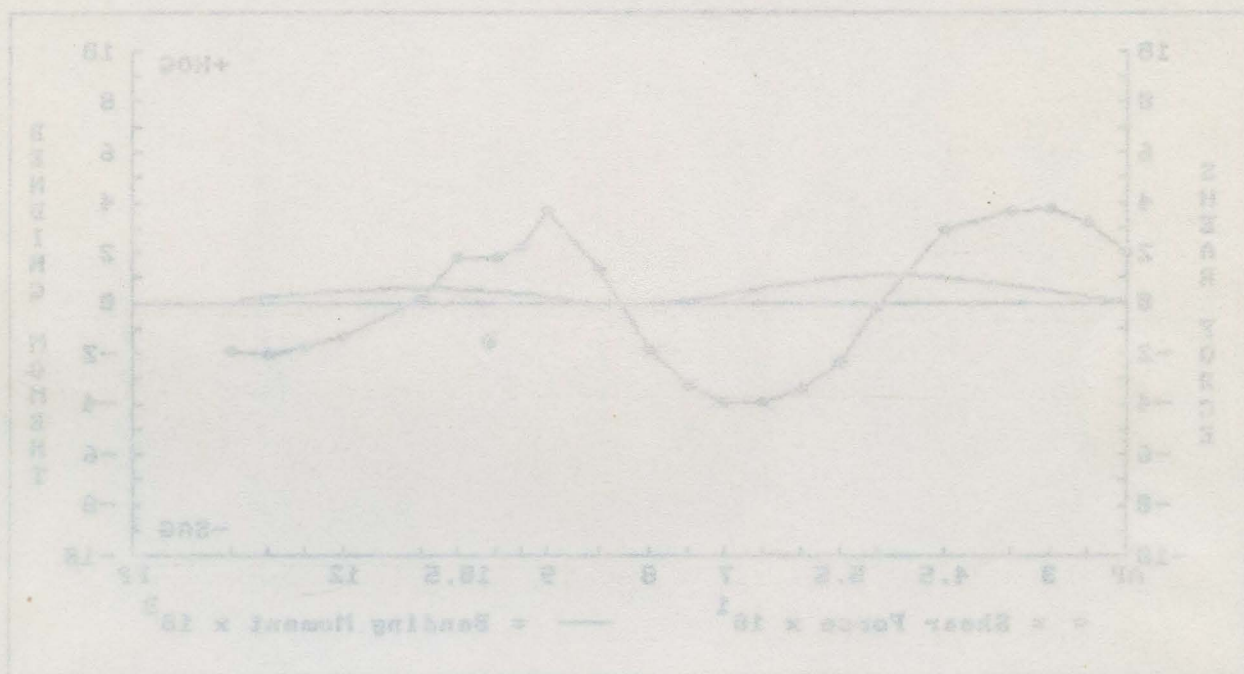


225 L. Tons of Ballast Added Amidships





# 22.1 Tons of Ballast Added Amidships





### Availability of Douglas Fir Timber

If *C.A. THAYER* is rebuilt, most of the timber will have to be replaced with new. Long lengths of Douglas Fir comparable to the quality of the original can be acquired with difficulty through special arrangements with the sawmills. To date, only one mill in Oregon has been identified that can saw the required lengths. Old growth timber is getting increasingly scarce and much of what remains is in National Forests. A tantalizing possibility for getting the best quality wood at the cheapest prices is for the NPS get the trees from the Forests and have them custom sawn. Generally, the price of Douglas Fir is between two and five thousand dollars per thousand board feet, depending on the grade and length. The price of custom sawing is between five hundred and a thousand dollars per thousand board feet, depending on the length.

Before the wood can be ordered, some decisions must be made about the nature of the restoration. Extremely long lengths of excellent quality of the timber were used everywhere in the original construction. The long lengths are less important to strength in the bottom of *THAYER* than they are in the upper hull and ceiling planking, waterway and clamp. As a rule, longer lengths of planking were used in the bottom planking than in the topside hull planking. From a structural standpoint, this should be reversed if the vessel is restored. This type of decision can only be made by NPS personnel in consultation with engineers. In addition, although the preservation ideal may be to replace wood with timber of equal quality and length, there might have to be some substitutions of length and grade. For example, since it is painted, a laminated waterway could be substituted for the existing timber. The appended timber list (Tri-Coastal Marine, 1990) should be regarded as preliminary until these decisions are made.

Whatever their source, these timbers will be green when they arrive from the mill. It is essential that the wood used in the topside hull and deck be very dry when it is installed. It is critical that the decking dry for several years before it is used. As soon as the decision to restore *C.A. THAYER* has been made, the timber must be bought and properly stored.



## Availability of Timber

W.C. WEAVER is rebuilt, most of the timber will have to be replaced with new. Long lengths of Douglas Fir comparable to the quality of the original can be acquired with difficulty through special arrangements with the sawmills. To date, only one mill in Oregon has been identified that can saw the required lengths. Old growth timber is getting increasingly scarce and much of what remains is in National Forests. A tantalizing possibility for getting the best quality wood at the cheapest prices is for the NPS to get the trees from the Forests and have them custom sawn. Generally, the price of Douglas Fir is between two and five thousand dollars per thousand board feet, depending on the grade and length. The price of custom sawing is between five hundred and a thousand dollars per thousand board feet, depending on the length.

Before the wood can be ordered, some decision must be made about the nature of the restoration. Extremely long lengths of excellent quality of the timber were used everywhere in the original construction. The long lengths are less important to strength in the bottom of the hull than they are in the upper hull and ceiling planking, waterway and clark. As a rule, longer lengths of planking were used in the bottom planking than in the topside hull planking. From a structural standpoint, this should be reversed if the vessel is restored. This type of decision can only be made by NPS personnel in consultation with engineers. In addition, although the preservation ideal may be to replace wood with timber of equal quality and length, there might have to be some substitutions of length and grade. For example, since it is painted, a laminated waterway could be substituted for the existing timber. The appended timber list (Tr-Coastal Marine, 1990) should be regarded as preliminary until these decisions are made.

Whatever their source, these timbers will be green when they arrive from the mill. It is essential that the wood used in the topside hull and deck be very dry when it is installed. It is critical that the decking dry for several years before it is used. As soon as the decision to restore W.C. WEAVER has been made, the timber must be bought and properly stored.





### Lumber Suppliers

American River Lumber Co. (Les Bjornsen)  
Portland, OR  
(503) 255-5240

American River is a lumber supplier. They have supplied Douglas Fir timber for the recently constructed *AVENGER* class U.S. Navy MCM vessels. They have also supplied timber for many wooden ships including *USS CONSTITUTION*. They supply timber up to 40'. Longer lengths in laminated timbers are available.

Hull Oaks (Wayne Giesy)  
Monroe, OR  
(503) 424-3112

Specialists in long length Douglas Fir timbers. They can saw 85' timber without changing their carriage. Custom sawing.

Northwest Woods (Cadian Hendricks)  
271 Hadlock Avenue  
Hadlock, WA 98339  
(206) 385-0842

Portable mill with 40' carriage.

Seattle Snohomish Mill (Bob Waltz, President)  
Snohomish, WA  
(206) 568-2171



## Timber Suppliers

American River Lumber Co. (Les Bjornson)

Portland, OR

(503) 252-3240

American River is a lumber supplier. They have supplied Douglas Fir timber for the recently constructed ANEWGER class U.S. Navy MCM vessels. They have also supplied timber for many wooden ships including USS CONSTITUTION. They supply timber up to 40'. Longer lengths in laminated timber are available.

Hill Oaks (Wayne Glass)

Monroe, OR

(503) 424-3113

Specialists in long length Douglas Fir timbers. They can saw 85' timber without changing their carriage. Custom sawing.

Northwest Woods (Cadian Hendricks)

271 Hadlock Avenue

Hadlock, WA 98339

(206) 382-0842

Portable mill with 40' carriage.

Santa Seaboard Mill (Bob Wells, President)

Seaboard, WA

(206) 364-2171



# Provisional Lumber List

Clamp (Pr. C-16)	6" x 14"	6" x 16"	4 @ 40'	40'	1,500	Select Struct.	Two pieces moided
Clamp (Pr. 16-56)	12-1/2" x 14"	14" x 16"	2 @ 100'	100'	3,750	Select Struct.	One piece moided
Clamp (Pr. 56-Transome)	6" x 14"	8" x 16"	4 @ 25'	40'	1,500	Select Struct.	Two piece moided
Thick Ceiling:							
Top strake	8" x 13"	10" x 14"	2 @ 160'	40' and 60'	3,750	Select Struct.	Scarfed
2nd. "	8" x 8"	10" x 10"	2 @ 160'	40' and 60'	1,700	" "	Butted
3rd. "	8" x 11"	10" x 12"	2 @ 160'	40' and 60'	3,200	" "	Butted
4th. "	8" x 12"	10" x 12"	4 @ 160'	40' and 60'	3,200	" "	Butted
5th. "	8" x 12"	10" x 12"	4 @ 160'	40' and 60'	3,200	" "	Scarfed, 7' to 8'
6th. "	8" x 13"	10" x 14"	4 @ 160'	80'	3,750	" "	Scarfed, 7' to 8'
7th. "	8" x 14"	10" x 14"	4 @ 160'	40' and 80'	3,750	" "	Scarfed, 7' to 8'
8th. "	8" x 16"	10" x 16"	2 @ 160'	80'	4,300	" "	Scarfed, 7' to 8'
Thin Ceiling	4" x 14"	4" x 16"	12 @ 150	40' and 60'	12,000	Select Struct.	
Hull Planking:							
Garboard	6" x 22"	8" x 24"	2 @ 145	80'	5,120	WCLB 177a.	"Ship Plank"
Bottom	4" x 16"	4" x 18"	16 @ 150	40', 60', 80'	15,360	WCLB 177a.	"Ship Plank"
	4" x 15"	4" x 18"	4 @ 155	40', 60', 80'	3,840	" "	" "
Bilge	4" x 12"	4" x 14"	18 @ 160	40' and 60'	13,440	WCLB 177a.	"Ship Plank"
Topside	4" x 10"	4" x 12"	4 @ 160	40' and 60'	2,560	WCLB 177a.	"Ship Plank"
	4" x 8"	4" x 10"	4 @ 160	40' and 60'	2,140	" "	" "
	4" x 6"	4" x 8"	14 @ 165	40'	6,160	" "	" "
Bulwark Planking	3" x 4"	4" x 4"	18 @ 170	40'	4,080	WCLB 177a.	"Ship Plank"
Deck Planking:							
Main	3-3/4" x 3-3/4"	4" x 4"	102 @ Various	20', 40', 60'	21,000	WCLB 175-a.	3/32" outgauge
Poop	3-3/4" x 3-3/4"	4" x 4"	74 @ 12'	14'	1,400	" "	" " "
			24 @ 24'	26'	830	" "	" " "
Top of Trunk	3-3/4" x 3-3/4"	4" x 4"	80 @ 25'	26'	2,800	WCLB 175-a.	3/32" outgauge
Waterways:							
Forward Section	6" x 12"	6" x 18"	2 @ 42'	24'	864	Select Struct.	
Midbody	6" x 10"	6" x 16"	2 @ 96'	100'	1,600	" "	Scarfed, 6'
Aft Section	6" x 21"	6" x 24"	2 @ 25'	26'	524	" "	Scarfed, 4'







<u>Item</u>	<u>Finish Dims.</u>	<u>Rough Dims.</u>	<u>No. of Runs</u>	<u>Length of Stock</u>	<u>Total B.F.</u>	<u>Grade</u>	<u>Comments</u>
Bulwark Cap Rail	5" x 17"	6" x 20"	2 @ 110'	20', 40'	2,200	Select Struct.	
Bulwark Clamp	3-1/2" x 10"	4" x 12"	2 @ 160'	40', 60'	1,300	Select Struct.	Scarfed, 5' to 6'
Stem	24" x 36"	30" x 40"	1 @ 36'	40'	4,000	Select Struct.	
Apron	16" x 24"	18" x 30"	1 @ 25'	30'	1,125	Select Struct.	
Kee	18" x 24"	20" x 30"	1 @ 150'	60'	9,000	Select Struct.	Scarfed, 12' - 14'
Keelson	16" x 19"	18" x 20"	1 @ 130'	40', 60'	4,200	Select Struct.	
Rider Keelson	16" x 17"	18" x 18"	1 @ 130'	40', 60'	3,800	Select Struct.	
Assist. Keelsons	18" x 18"	20" x 20"	4 @ 130'	60', 90'	21,330	Select Struct.	Scarfed, 14' - 16'
Deadwoods	16" x 24"	18" x 30"	5 @ 90' total	15', 30'	4,050	Select Struct.	
Sternpost	24" x 24"	24" x 24"	1 @ 10', 1 @ 25'	12', 30'	2,016	Select Struct.	

Bow Framing (6 double-sawn frames):

Naval Timbers	10" x 14"	10" x 18"	12 @ 8', 12 @ 12'	10' and 14'	4,320	Select Struct.	Shaped
Lower Futtocks	10" x 12"	10" x 18"	24 @ 8' to 10'	10'	3,600	" "	"
Top Timbers	10" x 10"	10" x 14"	24 @ 7' to 11'	10'	2,840	" "	"

Forebody Framing (11 double-sawn frames):

Floors	10" x 14"	10" x 30"	11 @ 12'	12'	3,300	Select Struct.	Shaped
Naval Timbers	10" x 14"	10" x 16"	22 @ 11.5'	12'	3,520	" "	"
Lower Futtocks	10" x 12"	10" x 16"	22 @ 11'	12'	2,933	" "	"
Bilge Futtocks	10" x 12"	10" x 24"	44 @ 8' to 9'	10'	8,800	" "	"
Top Timbers	10" x 10"	10" x 16"	22 @ 7', 22 @ 11'	8' and 12'	4,986	" "	"

Midbody Framing (36 double-sawn frames):

Floors	10" x 14"	10" x 30"	36 @ 15'	16'	14,400	Select Struct.	Shaped
Naval Timbers	10" x 14"	10" x 18"	72 @ 13'	14'	15,120	" "	"
Lower Futtocks	10" x 12"	10" x 18"	72 @ 8.5'	10'	10,800	" "	"
Bilge Futtocks	10" x 12"	10" x 24"	72 @ 6.5'	8'	11,520	" "	"
	10" x 12"	10" x 30"	72 @ 7'	8'	14,400	" "	"
Top Timbers	10" x 10"	10" x 18"	72 @ 8'	8'	8,640	" "	"
	10" x 10"	10" x 12"	72 @ 10'	10'	7,200	" "	"

Afterbody Framing (8 double-sawn frames):

Naval Timbers	10" x 14"	10" x 18"	16 @ 6.5'	8'	1,920	Select Struct.	Shaped
	10" x 14"	10" x 24"	16 @ 10'	12'	3,200	" "	"
Lower Futtocks	10" x 12"	10" x 18"	32 @ 9'	10'	4,800	" "	"
Bilge Futtocks	10" x 12"	10" x 24"	16 @ 6.5'	8'	2,560	" "	"
Top Timbers	10" x 10"	10" x 14"	16 @ 6'	8'	1,493	" "	"
	10" x 10"	10" x 24"	16 @ 9'	10'	3,200	" "	"







<u>Item</u>	<u>Finish Dims.</u>	<u>Rough Dims.</u>	<u>No. of Runs</u>	<u>Length of Stock</u>	<u>Total B.F.</u>	<u>Grade</u>	<u>Comments</u>
Stern Framing	10" x 12"	10" x 12"	12 @ 7'	8'	960	Select Struct.	
Main Deck Beams	9" x 11-1/2"	10" x 12"	1 @ 24'	24'	240	Select Struct.	
	11-1/2" x 12"	12" x 12"	10 @ 8' to 12'	12'	1,440	" "	
	11-1/2" x 14"	12" x 14"	8 @ 34'	34'	3,808	" "	
			5 @ 32'	32'	2,240	" "	
			5 @ 30'	30'	2,100	" "	
			4 @ 26'	26'	1,456	" "	
			4 @ 12'	12'	672	" "	
	11-1/2" x 16"	12" x 16"	3 @ 32'	32'	1,536	" "	
			5 @ 34'	34'	2,720	" "	
			1 @ 12'	12'	192	" "	
Hold Pillars	8" x 14"	8" x 14"	14 @ 6.5' to 8'	8'	1,045	Select Struct.	
			6 @ 8.5' to 10'	10'	560	" "	
			1 @ 10.5	12'	112	" "	
	8" x 16"	8" x 16"	4 @ 6.5' to 8'	8'	341	" "	
			4 @ 8.5' to 10'	10'	427	" "	
Pillar Clamps	4" x 10"	4" x 10"	2 @ 15.5'	16'	107	Select Struct.	
			4 @ 35'	40'	533	" "	
Mast Step Timbers	11.5" x 16"	12" x 16"	6 @ 4'	4'	384	Select Struct.	
Forecastle Head Deck							
Deck Planks	3-3/4" x 3-3/4"	4" x 4"	64 @ Various	(use cuts from main deck)		WCLB 175-a"	3/32" outgauge
Deck Beams	1 @ 8" x 16"	12" x 18"	1 @ 20'	20'	360	Select Struct.	Shaped for camber
	4 @ 8" x 12"	12" x 14"	4 @ 8' to 19'	10', 14', 18', 20'	868	" "	" " "
Margin Planks	5" x 13-1/2"	6" x 16"	1 @ 21'	1 @ 24'	192	Select Struct.	
	5" x 18"	6" x 24"	2 @ 24'	4 @ 16'	768	" "	Shaped
Log Rail	8" x 12"	14" x 14"	2 @ 31'	2 @ 15', 2 @ 18'	1,078	Select Struct.	Shaped, scarfed
Windlass Found.	7-1/2" x 14"	8" x 16"	2 @ 13'	2 @ 14'	300	Select Struct.	
Mast Partners	8" x 18"	10" x 18"	6 @ 16'	6 @ 16'	1,440	Select Struct.	
Hatch Coamings	12" x 17"	14" x 18"	4 @ 24'	4 @ 26'	2,185	Select Struct.	
			2 @ 21'	2 @ 24'	1,006	" "	
			2 @ 9'	2 @ 10'	420	" "	
Hatch Carlings	12" x 16"	14" x 18"	2 @ 15'	2 @ 16'	672	Select Struct.	
			2 @ 19'	2 @ 20'	840	" "	
House Sills	11-1/2" x 16"	12" x 16"	2 @ 34'	2 @ 36'	1,152	Select Struct.	
	11-1/2" x 12"	12" x 14"	2 @ 16'	2 @ 18'	504	" "	







<u>Item</u>	<u>Finish Dims.</u>	<u>Rough Dims.</u>	<u>No. of Runs</u>	<u>Length of Stock</u>	<u>Total B.F.</u>	<u>Grade</u>	<u>Comments</u>
Hanging Knees	10" x 46" x 64"	12" x 60" x 72"	46 total	12 pcs.	2,304 approx.	grown knees	Custom order
Lodging Knees	6" x 30" x 36"	8" x 36" x 48"	16 total	8 pcs.	320 approx.	grown knees	Custom order
<b>Poop Deck</b>							
Poop Bulkhead Sill	9" x 16-1/2"	10" x 18"	1 @ 29'	1 @ 33'	510	Select Struct.	
Poop Bulkhead	6" x 8"	8" x 8"	9 @ 33'	9 @ 34'	1,632	Select Struct.	
Poop Deck Beams	9" x 12"	10" x 12"	2 @ 26'	2 @ 30'	560	Select Struct.	
			16 @ 40"	4 @ 16'	640	" "	
	11" x 16"	12" x 16"	1 @ 28'	1 @ 30'	480	" "	
Poop Margin Planks	5" x 16"	6" x 24"	1 @ 25'	2 @ 16'	384	Select Struct.	
			2 @ 44'	4 @ 28'	1,344	" "	
Poop Log Bulwark	8-1/2" x 10"	12" x 14"	1 @ 25'	2 @ 16'	448	Select Struct.	
			2 @ 44'	4 @ 24'	1,372	" "	
Poop Cap Rail	4" x 10-1/2"	6" x 16"	1 @ 25'	2 @ 16'	256	Select Struct.	
			2 @ 44'	4 @ 24'	784	" "	
Poop Taff Rail	3" x 7-1/2"	4" x 14"	1 @ 25'	2 @ 16'	150	Select Struct.	
			2 @ 32'	2 @ 20'	187	" "	
Transome Planking	4" x 8"	4" x 10"	10 @ 26'	10 @ 30'	1,000	WCLB 177-a.	"Ship Plank"
	4" x 12"	4" x 14"	1 @ 25'	1 @ 30'	140	" "	" "
Hold Pillars	8" x 14"	10" x 14"	15 @ 7' to 11'	12 @ 10', 3 @ 12'	1,820	Select Struct.	
	8" x 16"	10" x 16"	8 @ 7' to 10'	8 @ 10'	1,067	" "	

Other Lumber not listed (some of this material may be salvageable)

Fisherman's Forecastle Sole, Joinery, and Bulkheads  
Deck House Framing and Joinery  
Aft Accomodations Joinery  
Unaccessible Bow and Stern Structure

Items to be Preserved

Catheads  
Bits (6) and Samson Post  
Wood Cleats  
Hanging Knees (estimated 75%, 34 out of 46)  
Hatch Lodging Knees (estimated 50%, 8 out of 16)  
Lumber Chutes  
Bulwark Pinrails  
Aft Cabin Trunk  
Pointers (3)  
Rudder and Stock









## APPENDIX V

STRATHMORE

25% COTTON FIBER



1-11-11

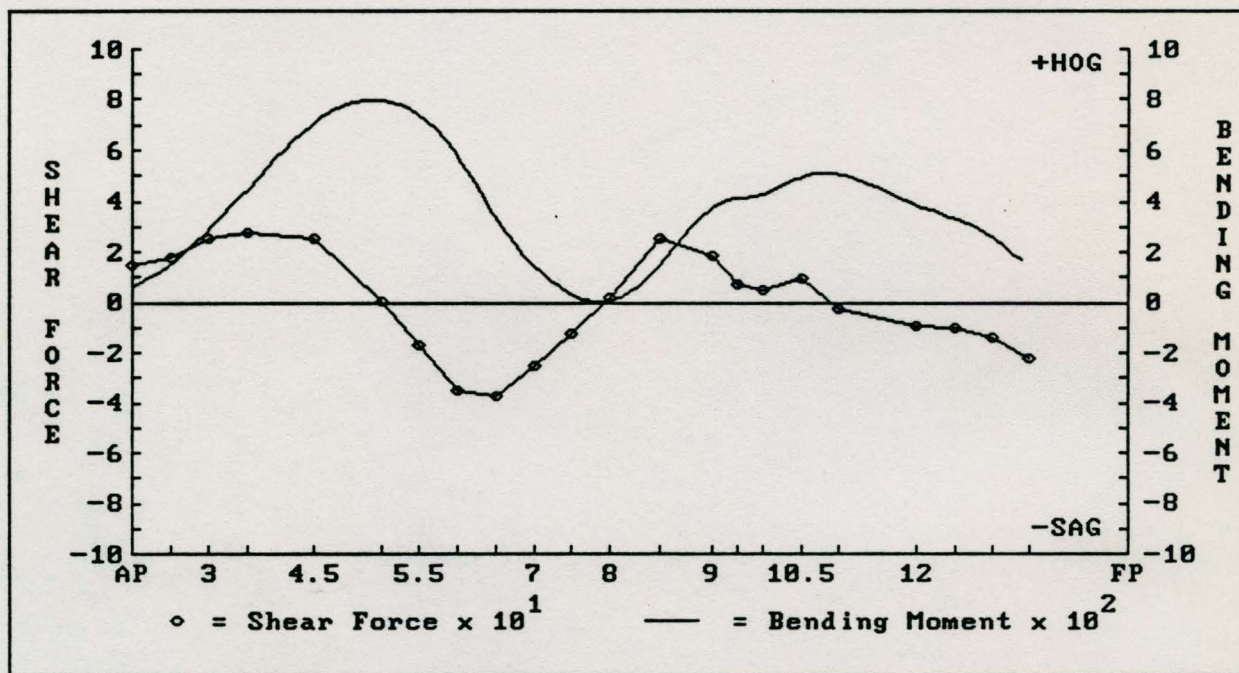
APPENDIX A

STATIONARY WHEELING

220 7221-10100X22

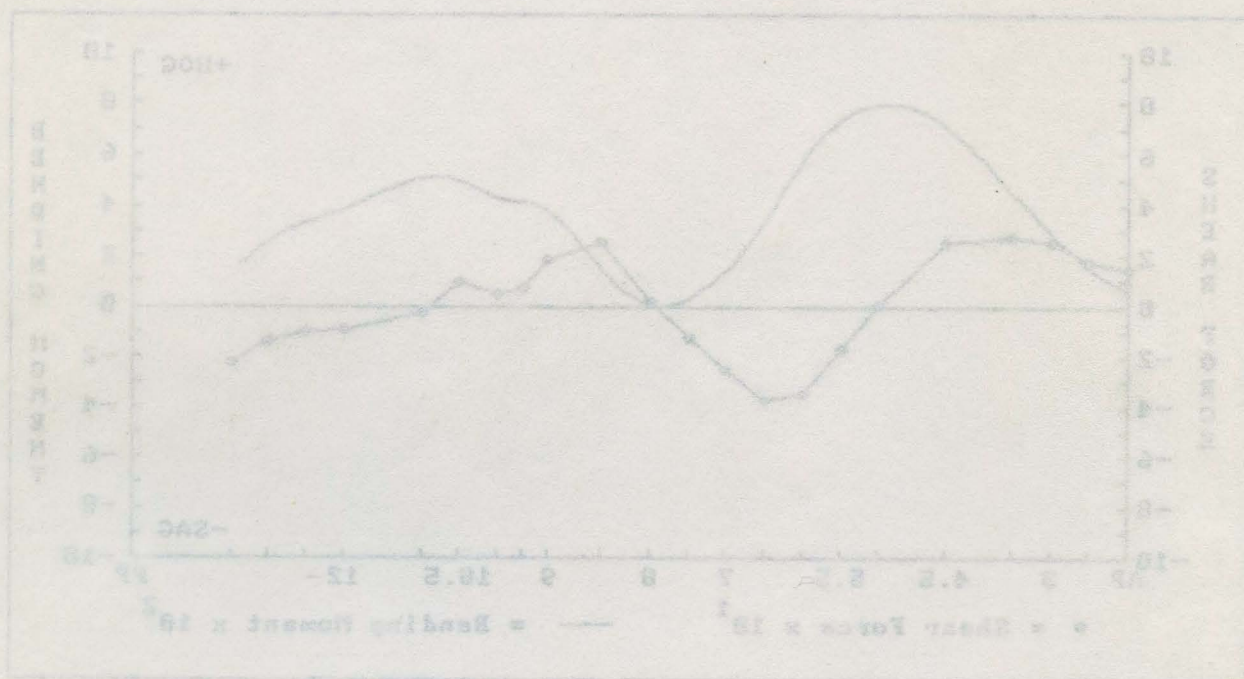


125 L. Tons of Ballast Added Amidships  
and 25 Tons of Buoyancy at Each End





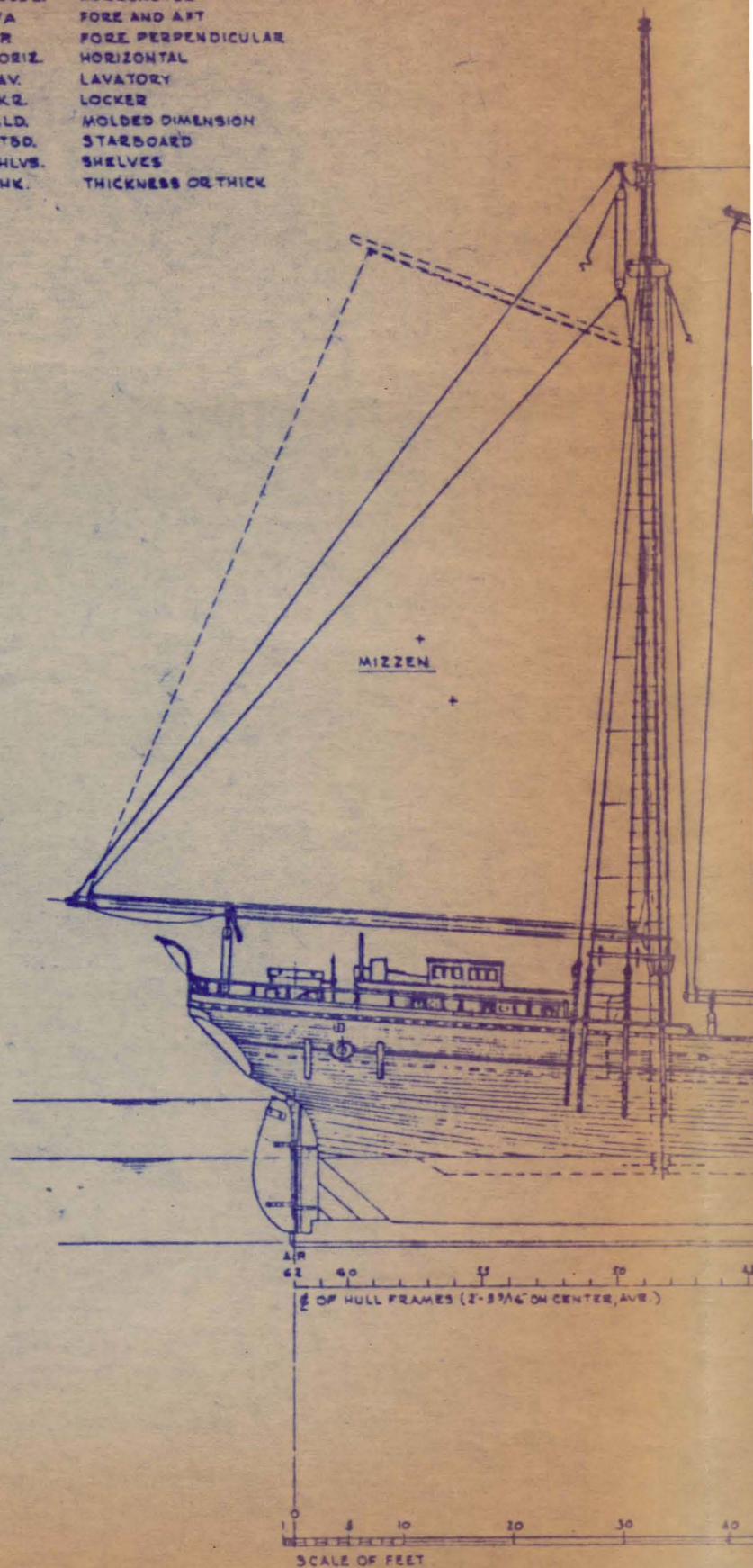
125 L. Tons of Ballast Added Amidships  
and 25 Tons of Buoyancy at Each End





# ABBREVIATIONS & SYMBOLS

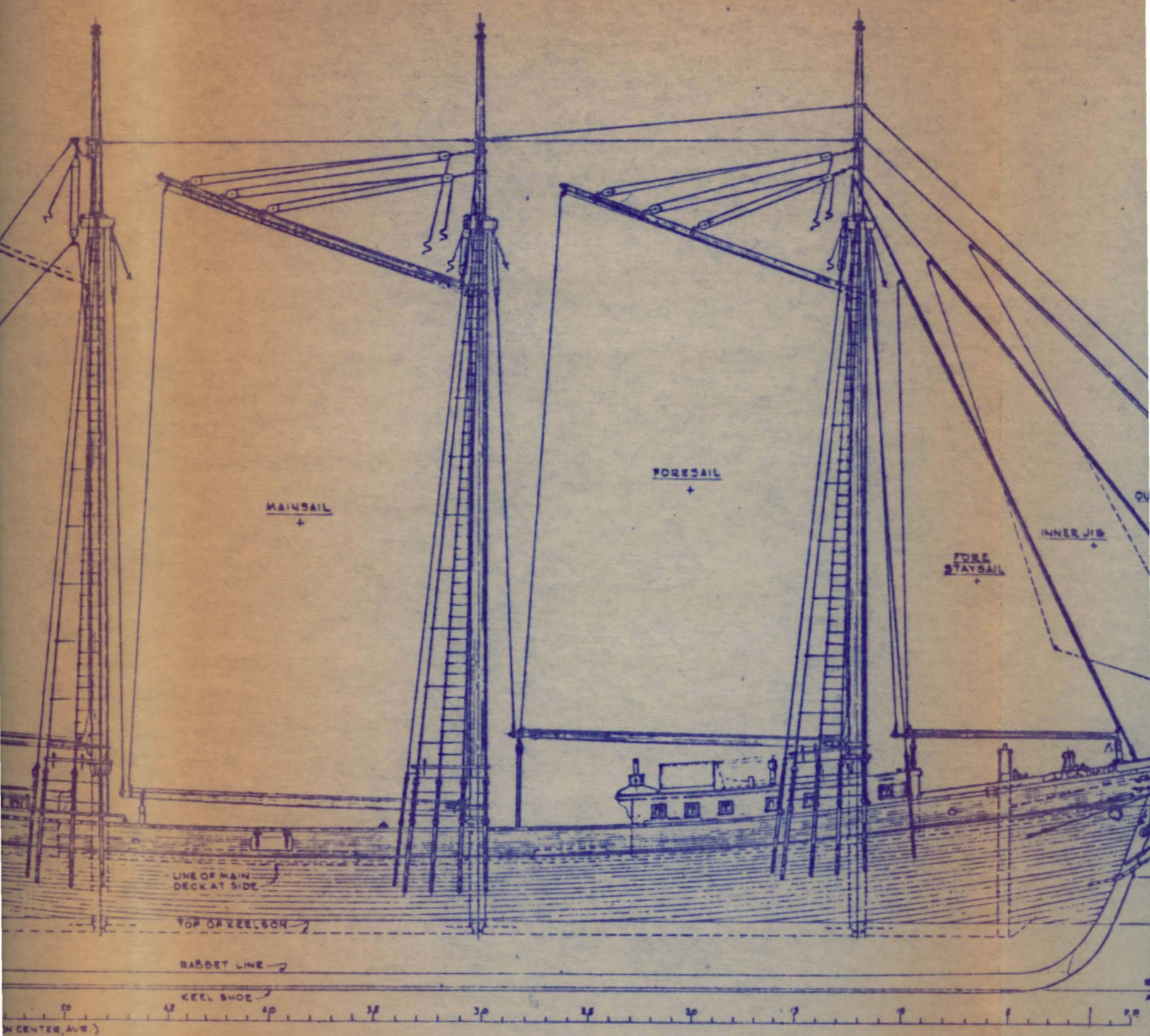
A.P.	AFT PERPENDICULAR	DL.	PLATE
ABT.	ABOUT (APPROXIMATE)	P/S	PORT AND STARBOARD
APPROX.	APPROXIMATE	T&G	TONGUE AND GROOVE SHEATHING
AVE.	AVERAGE	W.C.	WATER CLOSET
CAB.	CABINET		
C.L.	CENTERLINE		
DIA.	DIAMETER		
FOCSL.	FORECASTLE		
F/A	FORE AND AFT		
F.P.	FORE PERPENDICULAR		
HORIZ.	HORIZONTAL		
LAV.	LAVATORY		
L.K.	LOCKER		
M.D.	MOLDED DIMENSION		
STD.	STARBOARD		
SHLV.	SHELVES		
THK.	THICKNESS OR THICK		





AND STARBOARD  
 AND GROOVE SHEATHING  
 CLOSET

WOOD: CROSS SECTION  
 LONGITUDINAL SECTION  
 UNDEFINED STRUCTURE



EXISTING COM

UNITED  
 DEPARTMENT  
 NATIONAL

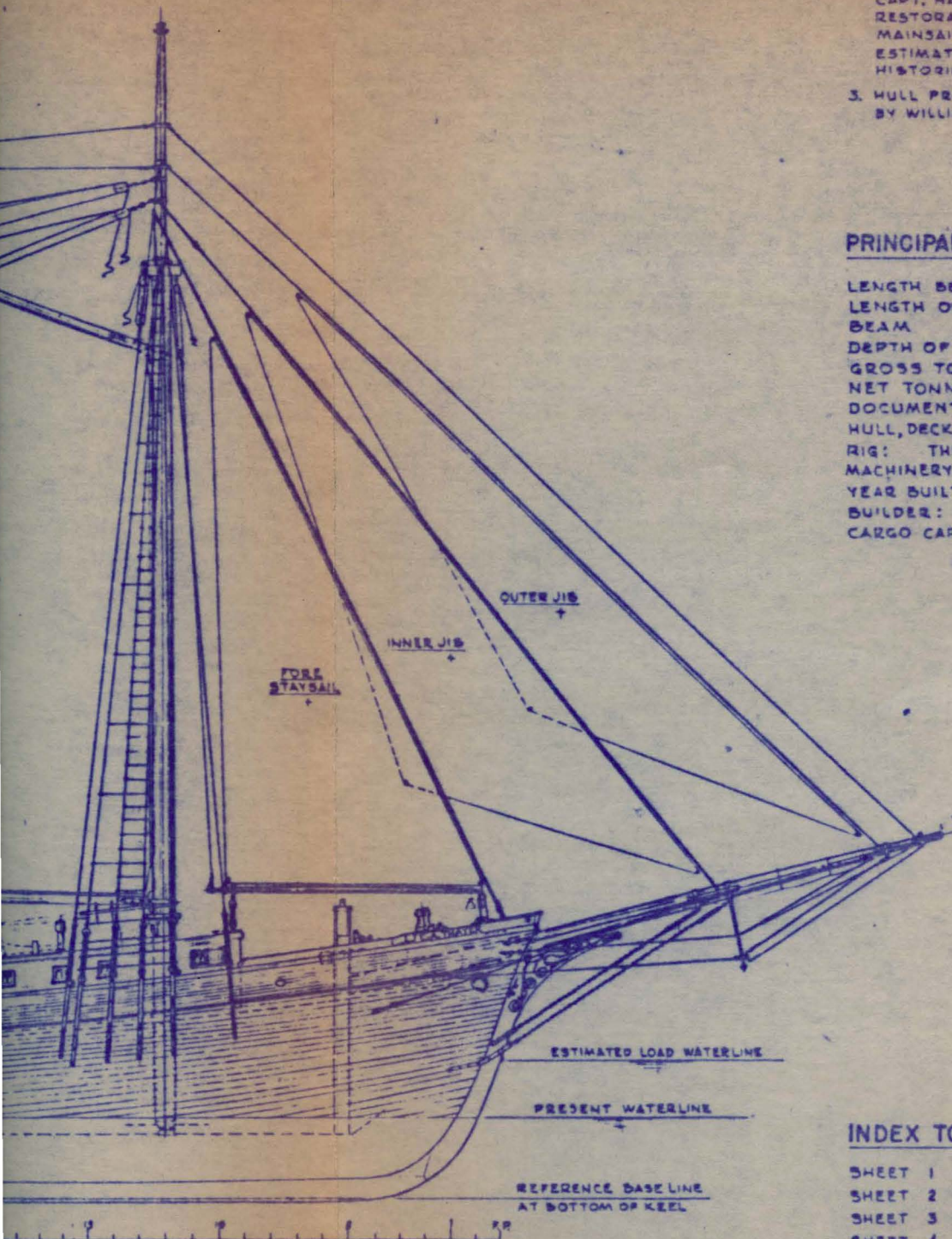


## GENERAL NOTES

1. THE PRESENT RIG IS A RECONSTRUCTION OF C.A. THAYER'S ORIGINAL RIG, WITH THE EXCEPTION OF THE JIB-HEADED MIZZEN WHICH WAS CARRIED DURING THE VESSEL'S LAST FOUR VOYAGES AS A CODFISHERMAN.
2. DIMENSIONS OF FORESAIL, MIZZEN, AND HEAD SAILS ARE BASED ON DOCUMENTATION FROM CAPT. HAROLD HUYCKE, DIRECTOR OF THE 1937 RESTORATION IN SEATTLE. DIMENSION OF MAINSAIL AND THE JIB-HEADED MIZZEN ARE ESTIMATED BASED ON SPAR LENGTHS AND HISTORIC PHOTOGRAPHS.
3. HULL PROFILE IS TAKEN FROM LINES DEVELOPED BY WILLIAM DOLL, SFMNH.

## PRINCIPAL CHARACTERISTICS

LENGTH BETWEEN PERPENDICULARS — 186'-0"  
 LENGTH OVERALL (HULL) — 168'-6"  
 BEAM — 56'-4"  
 DEPTH OF HOLD — 11'-8"  
 GROSS TONNAGE — 452  
 NET TONNAGE — 331  
 DOCUMENTATION NUMBER — 127097  
 HULL, DECKS, AND SPARS: DOUGLAS FIR  
 RIG: THREE-MASTED BALD-HEADED SCHOONER  
 MACHINERY: STEAM DONKEY ENGINE IN DECK HOUSE  
 YEAR BUILT: 1893  
 BUILDER: HANS BENDIXSEN, FAIRHAVEN, CALIFORNIA  
 CARGO CAPACITY: 375,000 BOARD FEET OF LUMBER



## INDEX TO DRAWINGS

SHEET 1 OUTBOARD PROFILE  
 SHEET 2 PLAN OF DECKS  
 SHEET 3 HOLD ARRANGEMENT  
 SHEET 4 INBOARD PROFILE  
 SHEET 5 MIDSHIP SECTION  
 SHEET 6 PIPING SYSTEM  
 SHEET 7 ELECTRICAL SYSTEM

### EXISTING CONDITION DRAWINGS

UNITED STATES  
 DEPARTMENT OF THE INTERIOR  
 NATIONAL PARK SERVICE

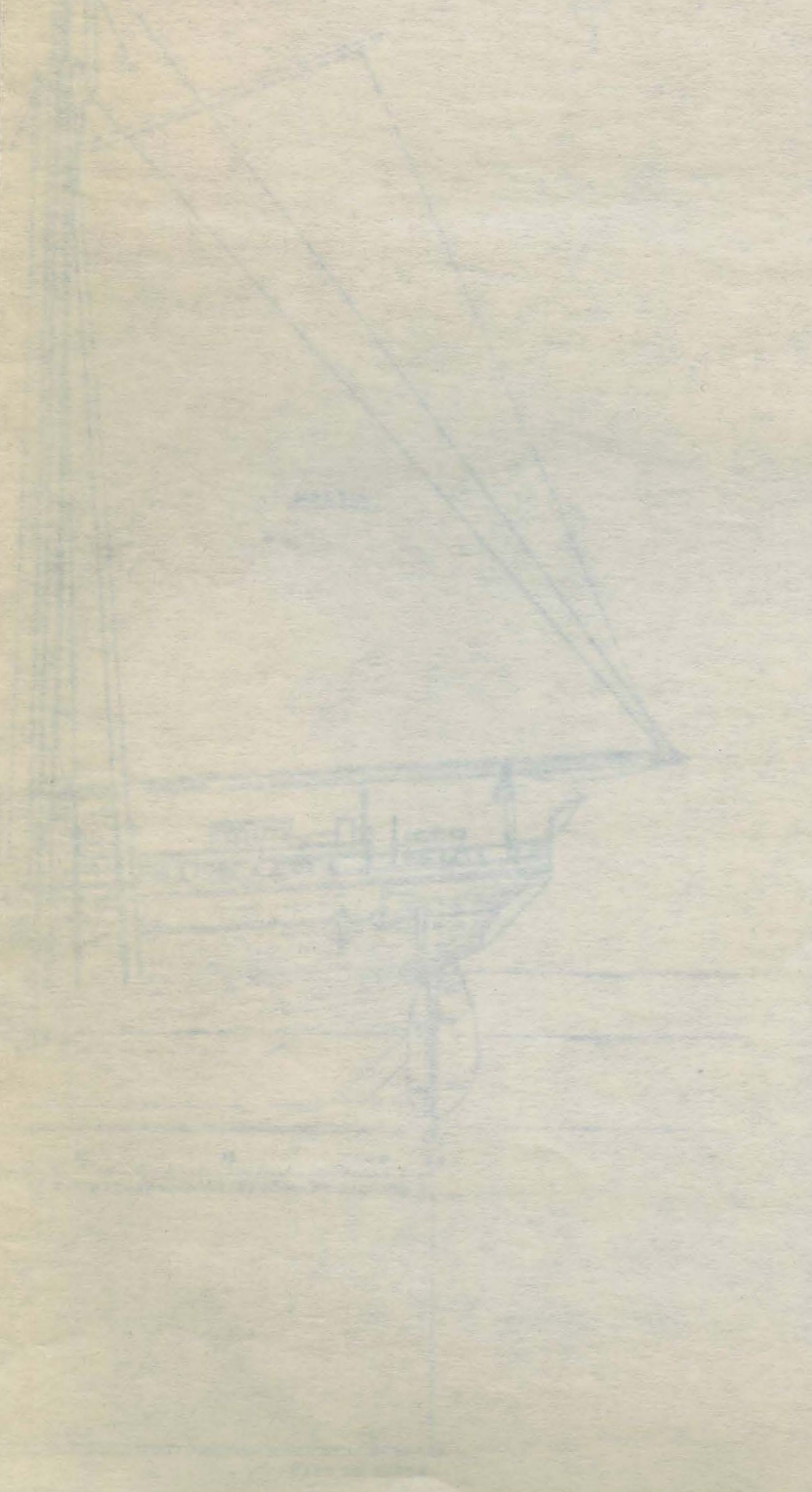
CONTRACTOR  
 TRI-COASTAL  
 MARINE  
 DRAWN  
 D. BIRKHOLZ SR.  
 TECH. REVIEW  
 D. BIRKHOLZ JR.  
 DATE  
 8/90

THREE-MASTED SCHOONER  
 "C.A. THAYER"  
 OUTBOARD PROFILE  
 SAN FRANCISCO MARITIME  
 NATIONAL HISTORICAL PARK

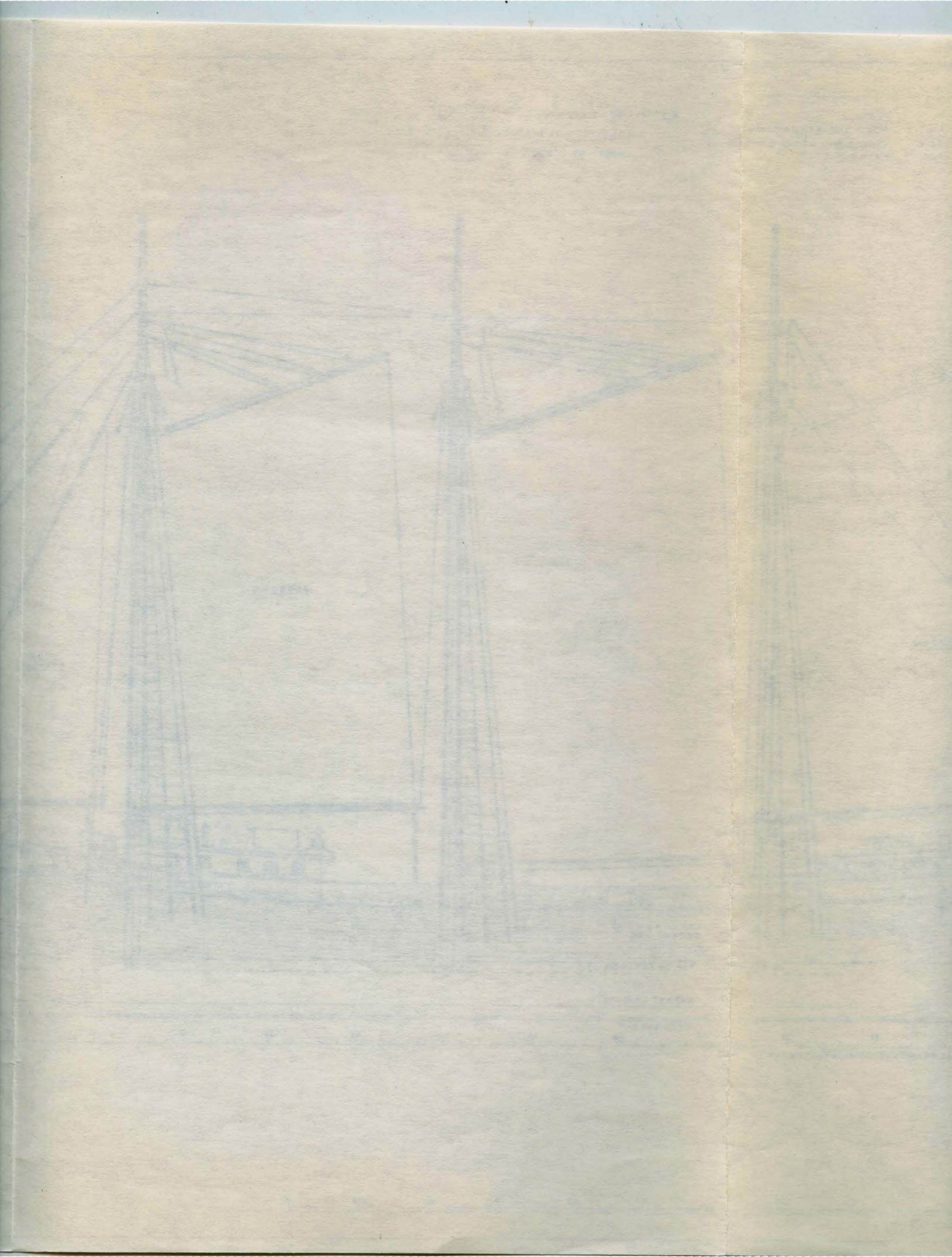
DRAWING NO.  
 350  
 60001  
 PKG. NO.  
 SHEET  
 1  
 OF 7



Handwritten notes and a table of data, likely related to a survey or measurement project. The text is faint and difficult to read, but appears to include a title and several lines of descriptive text followed by a table with multiple columns and rows of numerical data.







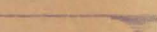
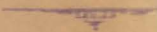




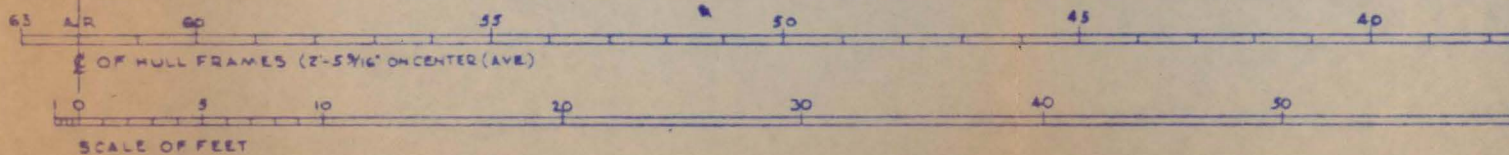
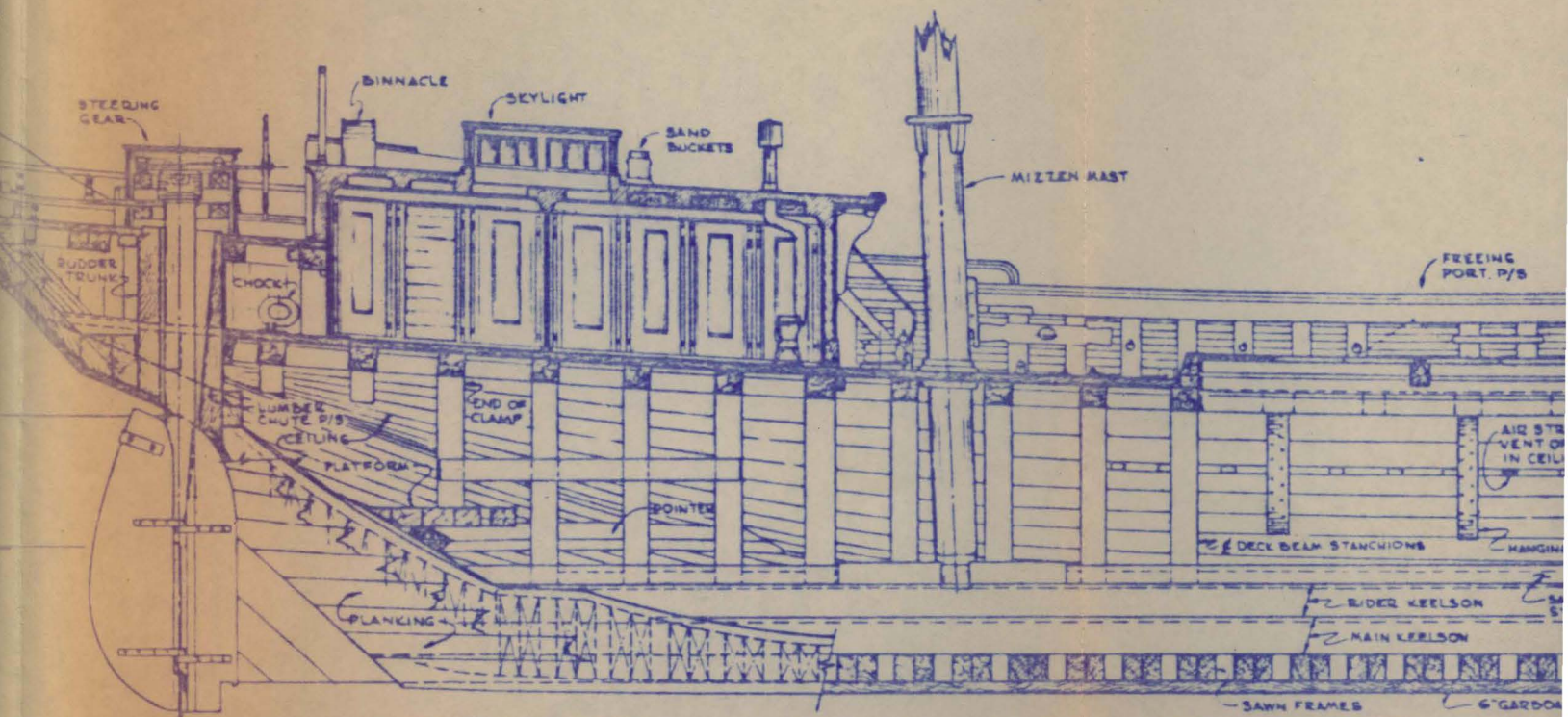




HORN TIMBER

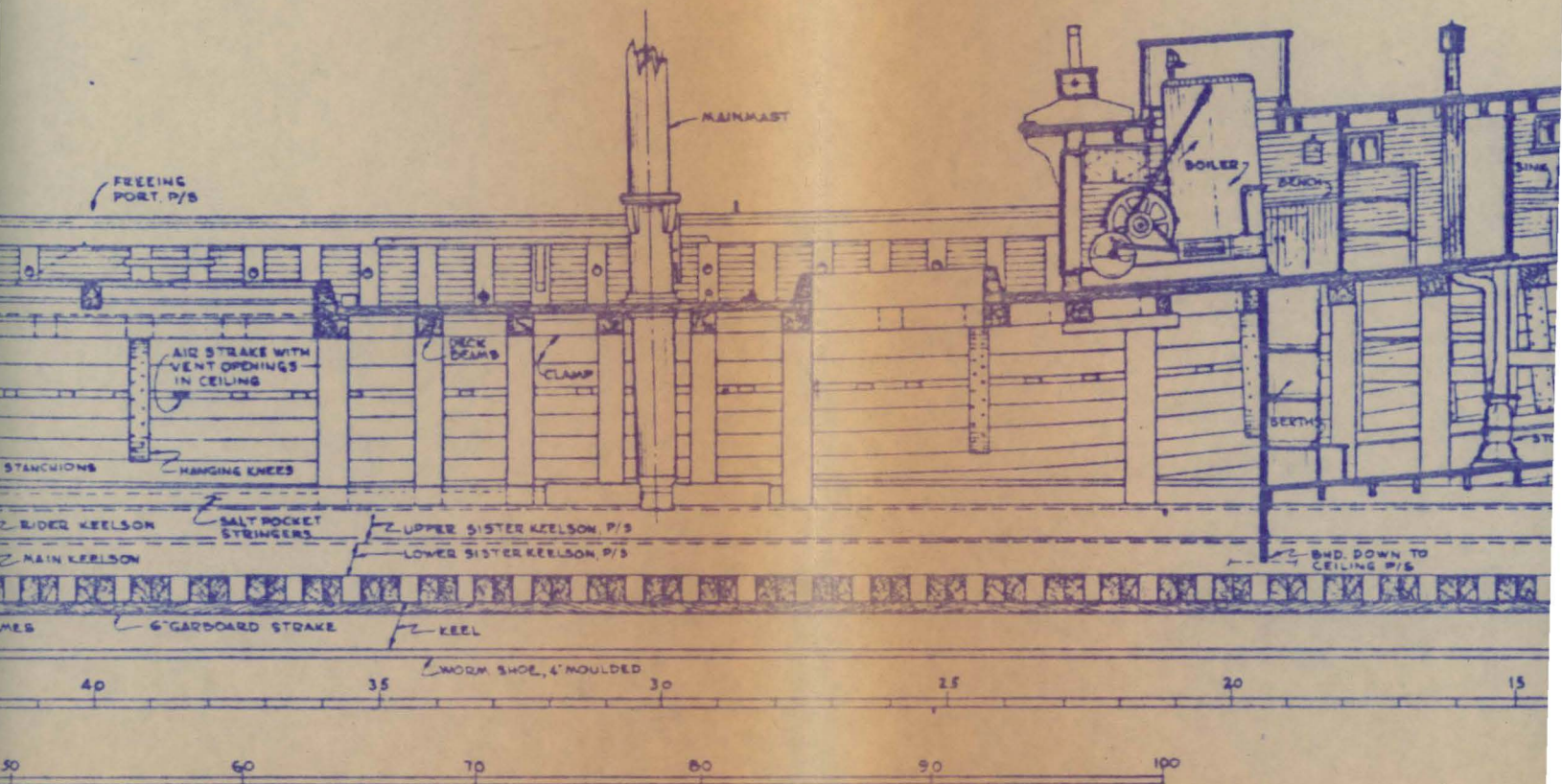






INBOARD PROFILE

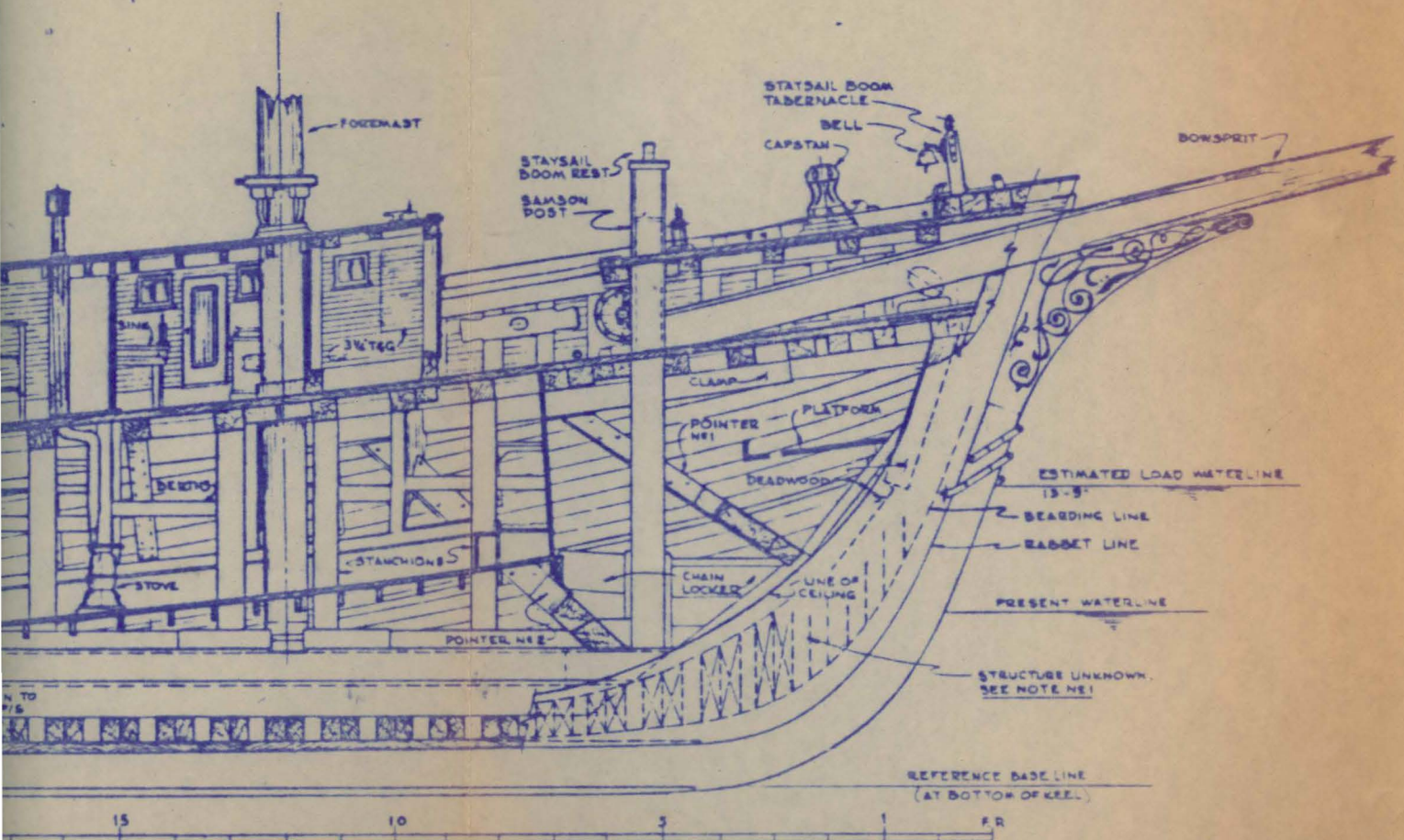






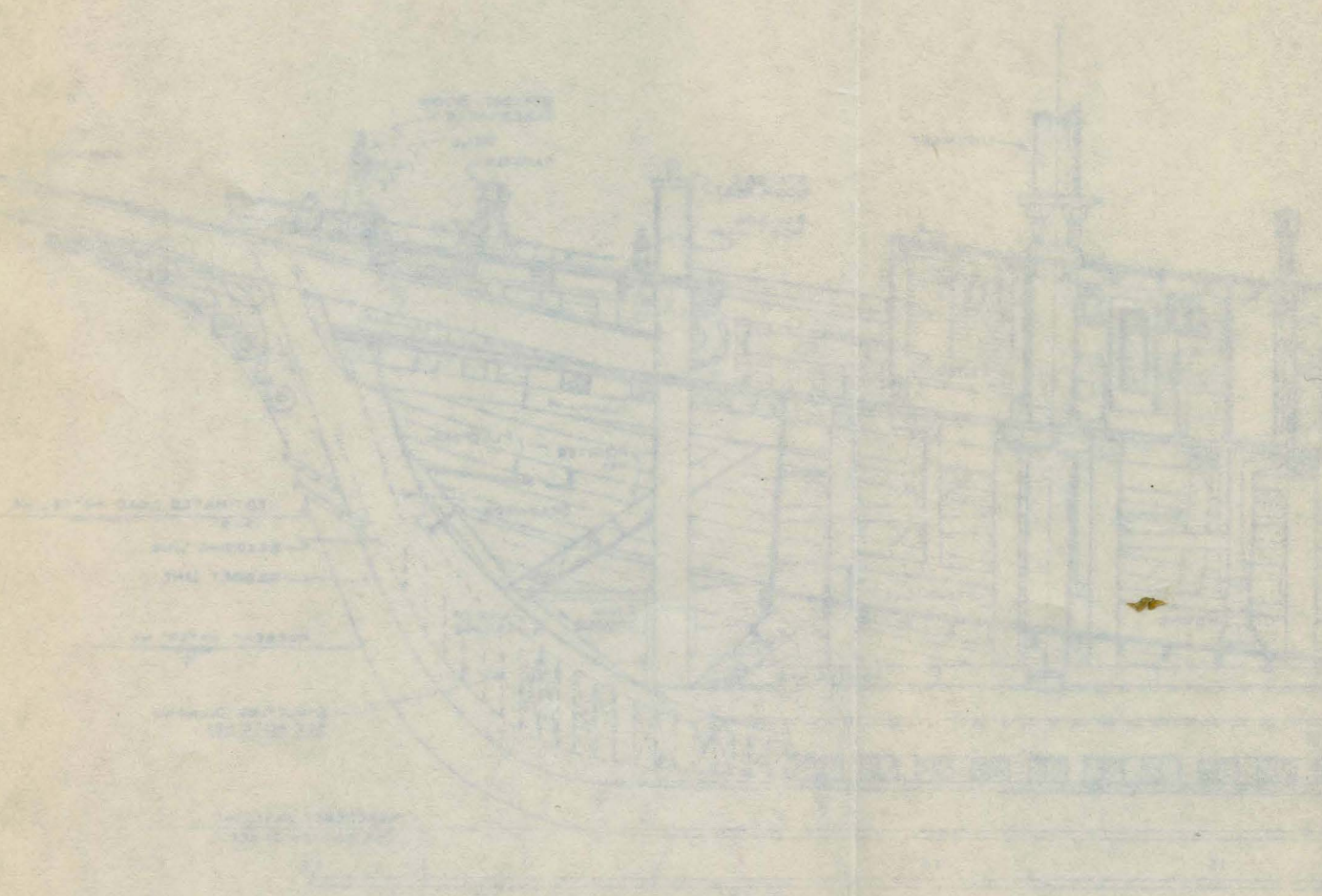
# NOTES

1. INTERNAL HULL STRUCTURE AT THE BOW AND STERN HAS NOT BEEN DOCUMENTED DUE TO LACK OF ACCESS. ARRANGEMENT AND DIMENSIONS GIVEN ARE APPROXIMATE ONLY.
2. VESSEL IS SHOWN WITHOUT EXISTING HOG. HOG HAS BEEN MEASURED AT 14" (DEC, 1988) WITH MAXIMUM HOG AT FRAME 34.

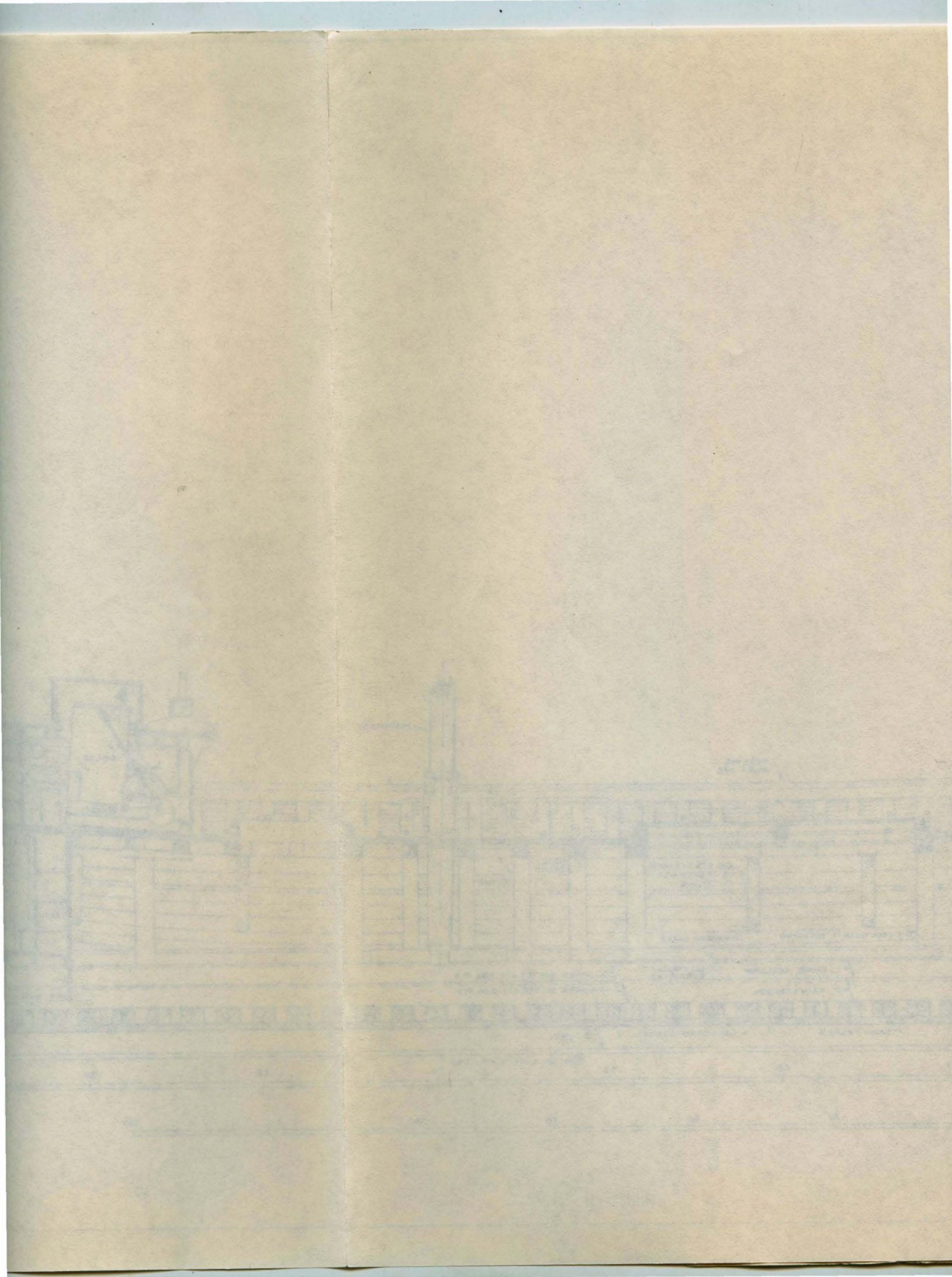


EXISTING CONDITION	THREE-MASTED SCHOONER "C.A. THAYER" INBOARD PROFILE SAN FRANCISCO MARITIME NATIONAL HISTORICAL PARK	DRAWING NO. 350 60001
DRAWN D. BIRCHOLZ JR.		PKG. NO.
TECH. REVIEW D. BIRCHOLZ JR.		SHEET 2
DATE 5-90		OF 7

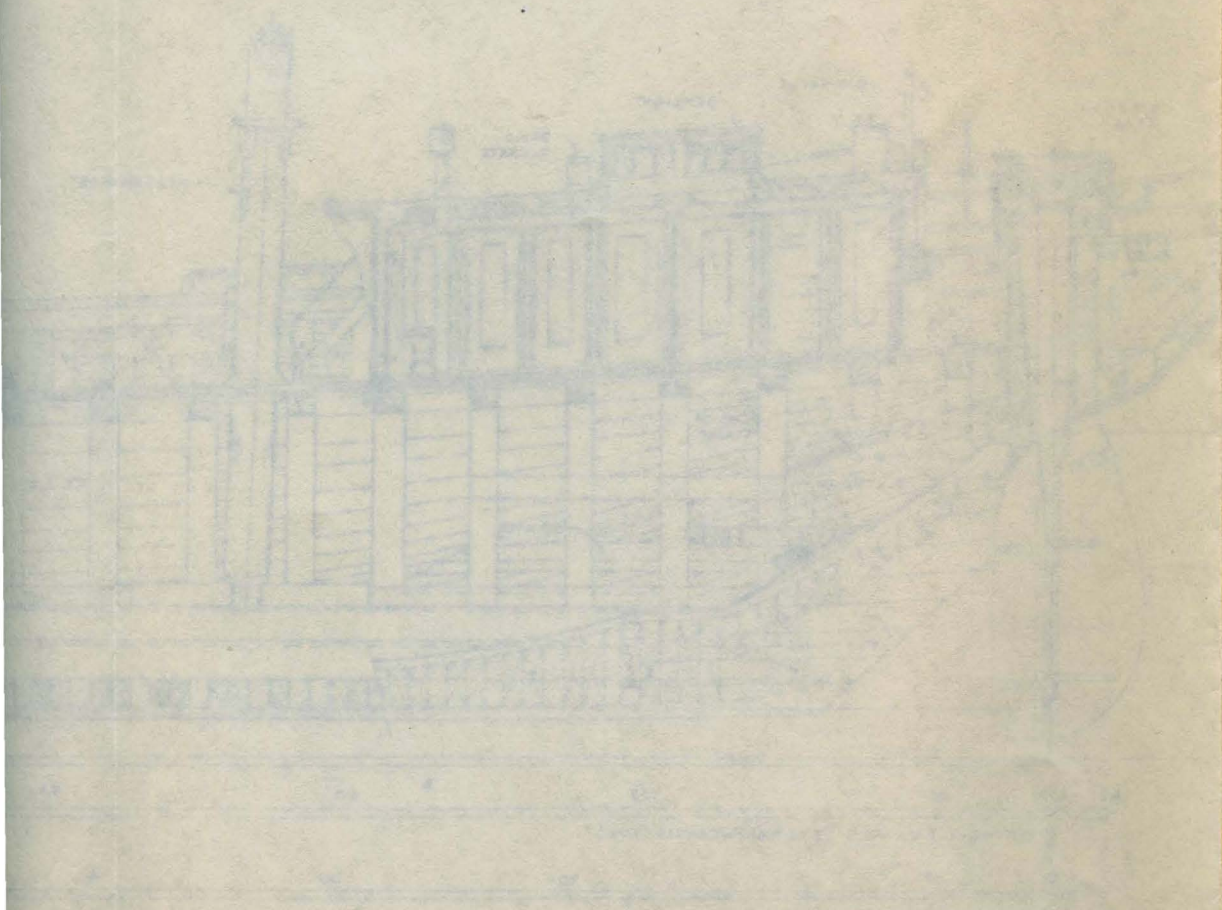



















CLOSED CHOCK P/B



NOTE: PLAN SECTION AT  
TRANSOM PORT SIDE  
TAKEN AT LINE OF  
MAIN DECK

LINE OF OUTSIDE OF  
TRANSOM PLANKING  
AT POOP DECK

SISTER TRANSOM  
FRAMES SHOWN  
THUS:   
SEE NOTE #12

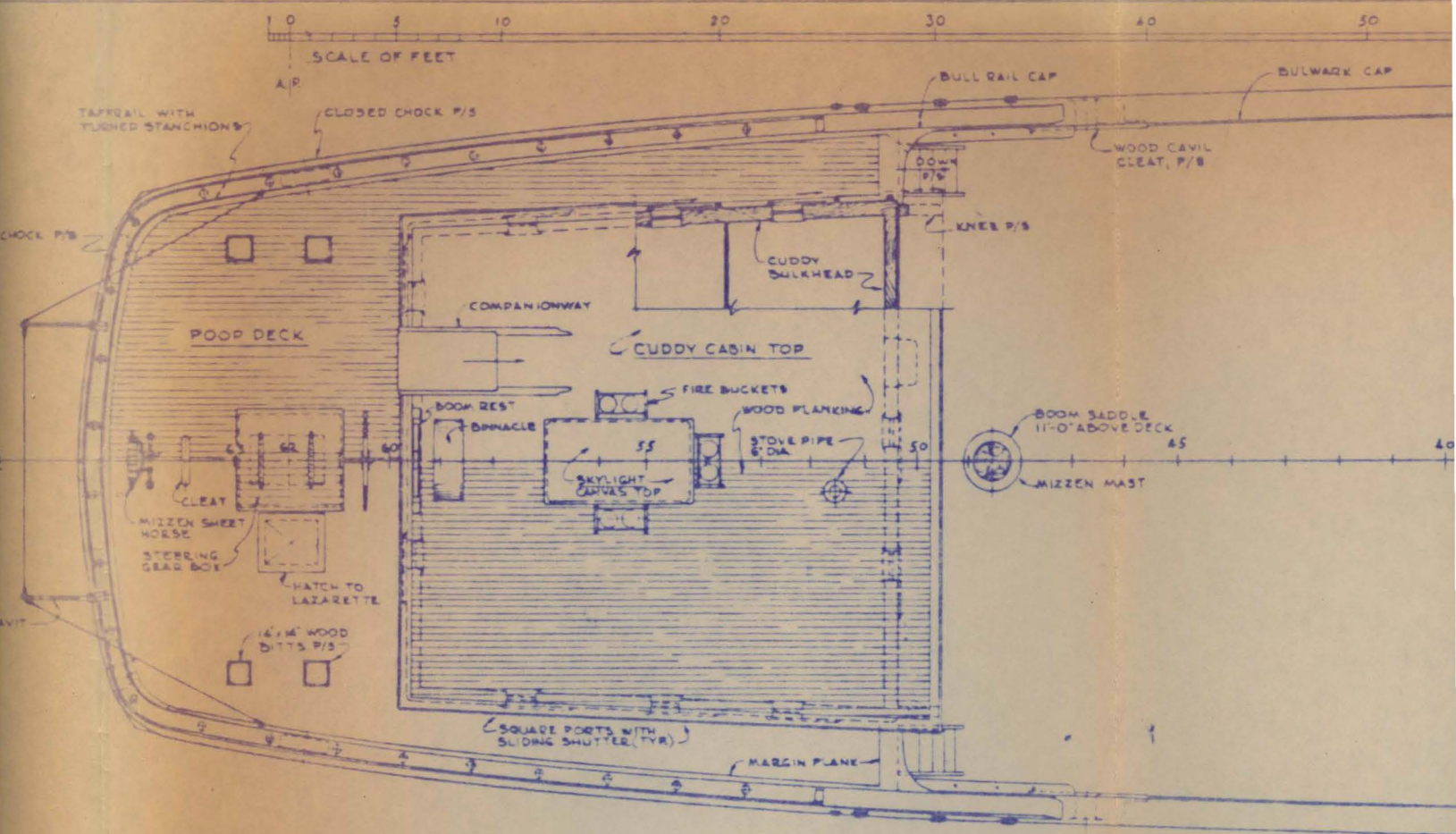
OF VESSEL

LUMBER PORT P/B

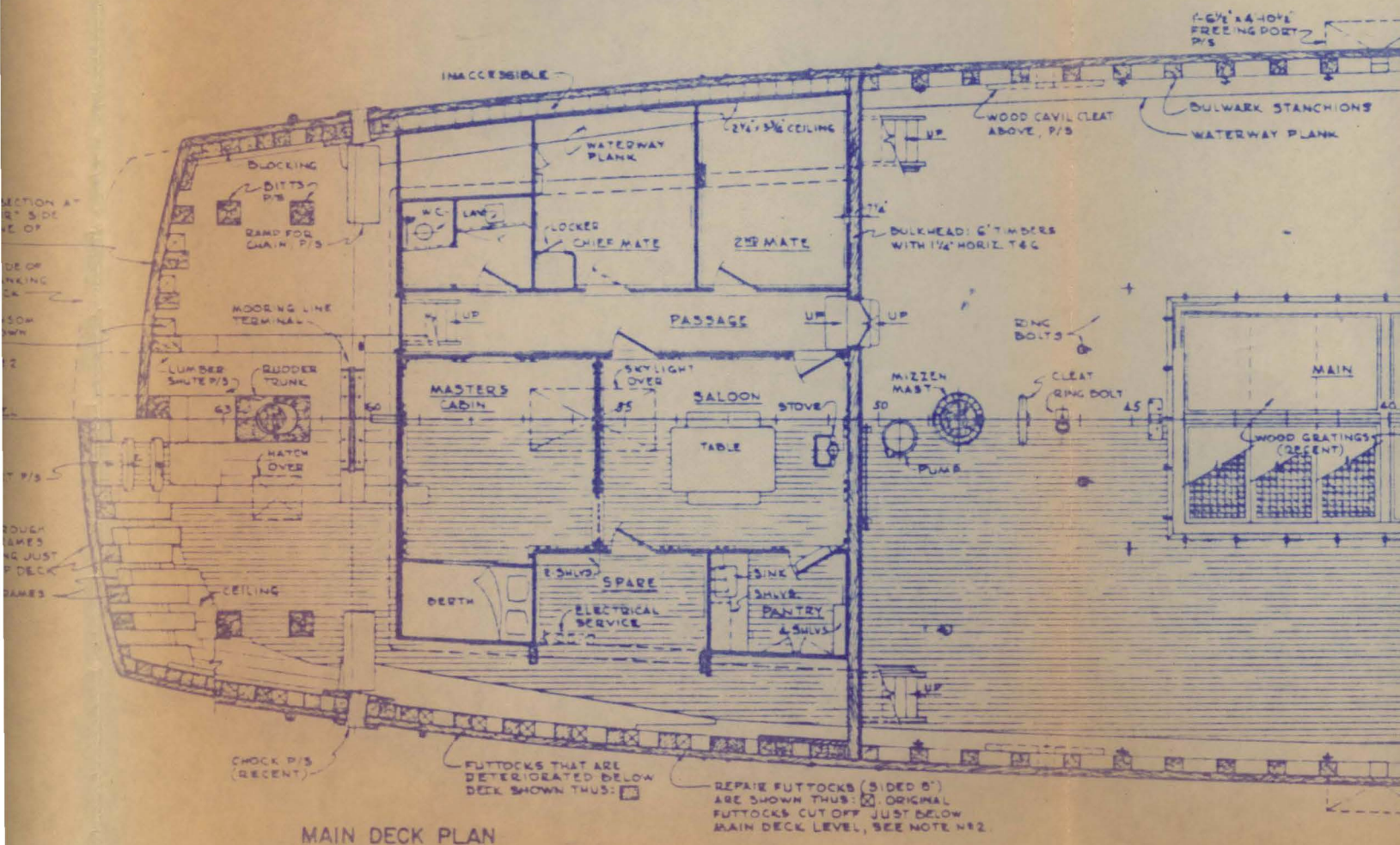
SECTION THROUGH  
TRANSOM FRAMES  
AND PLANKING JUST  
BELOW POOP DECK

TRANSOM FRAMES

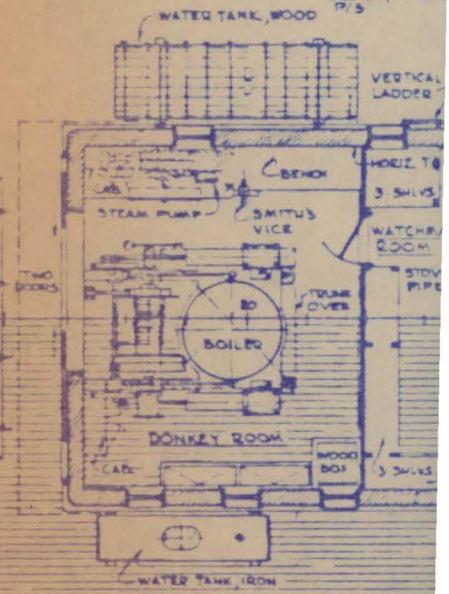
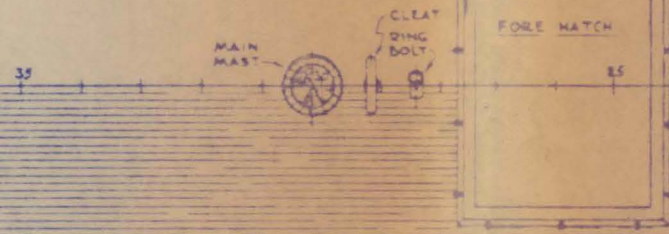
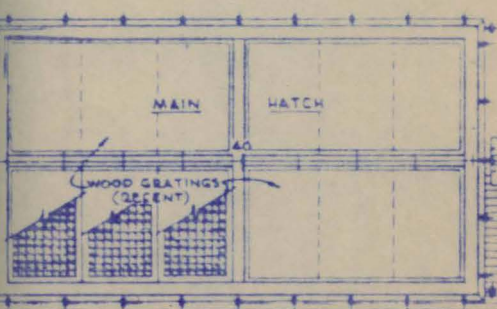
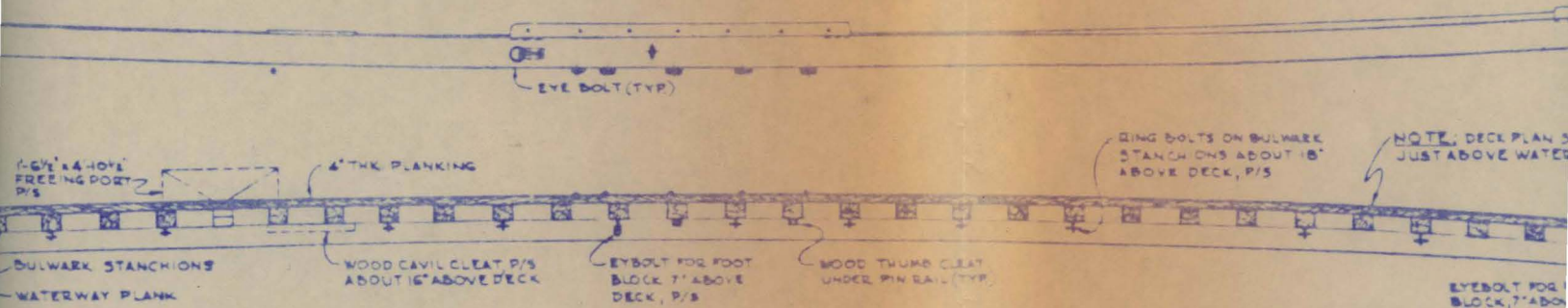
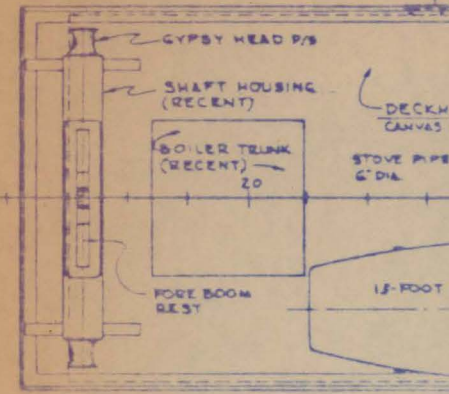
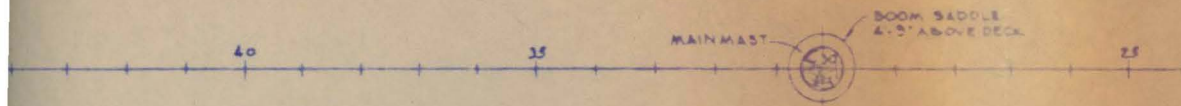
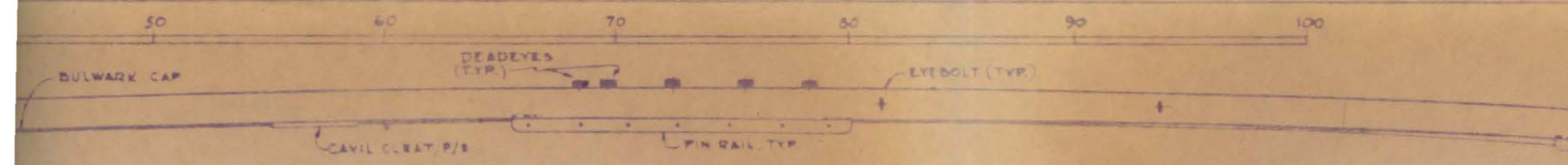




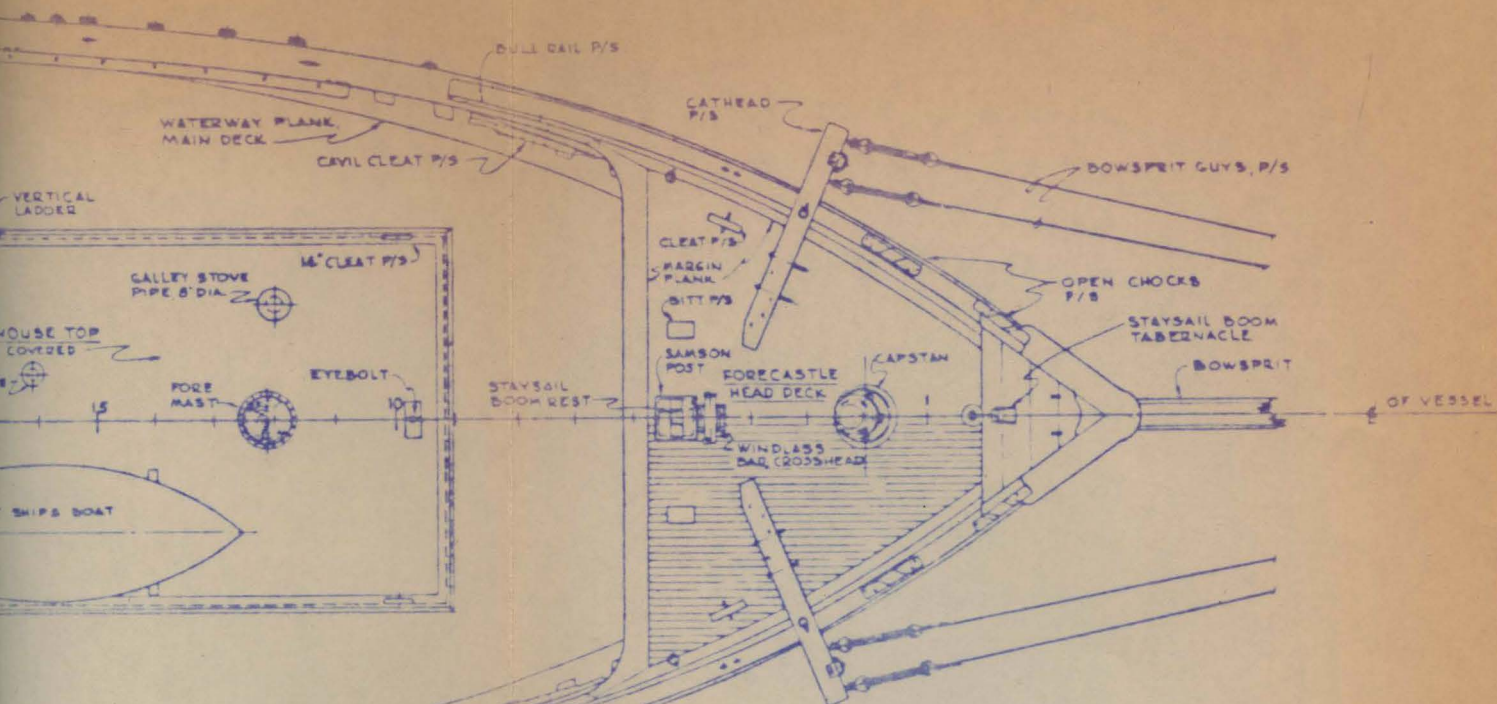
POOP DECK & FORECASTLE HEAD DECK PLAN



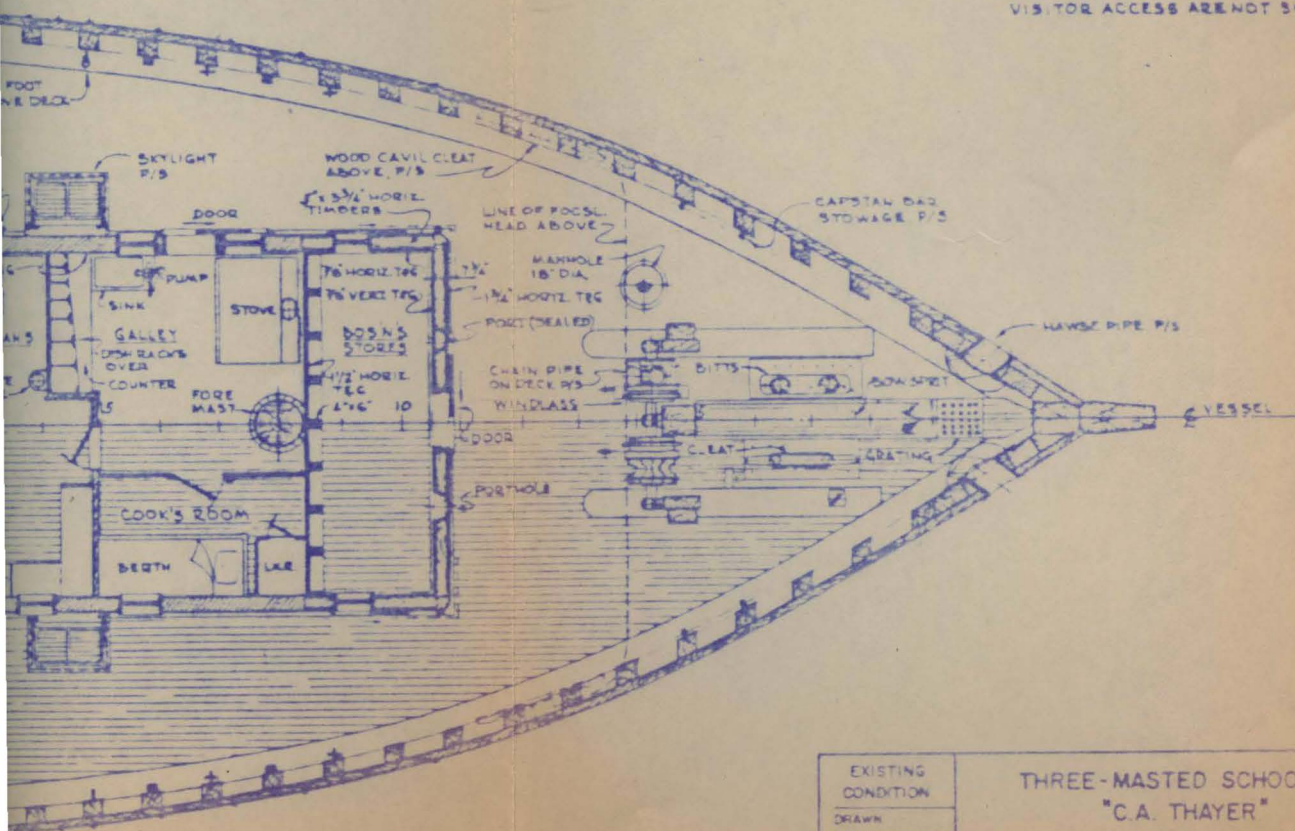








SECTION TAKEN  
THROUGH PLANK.



#### NOTES

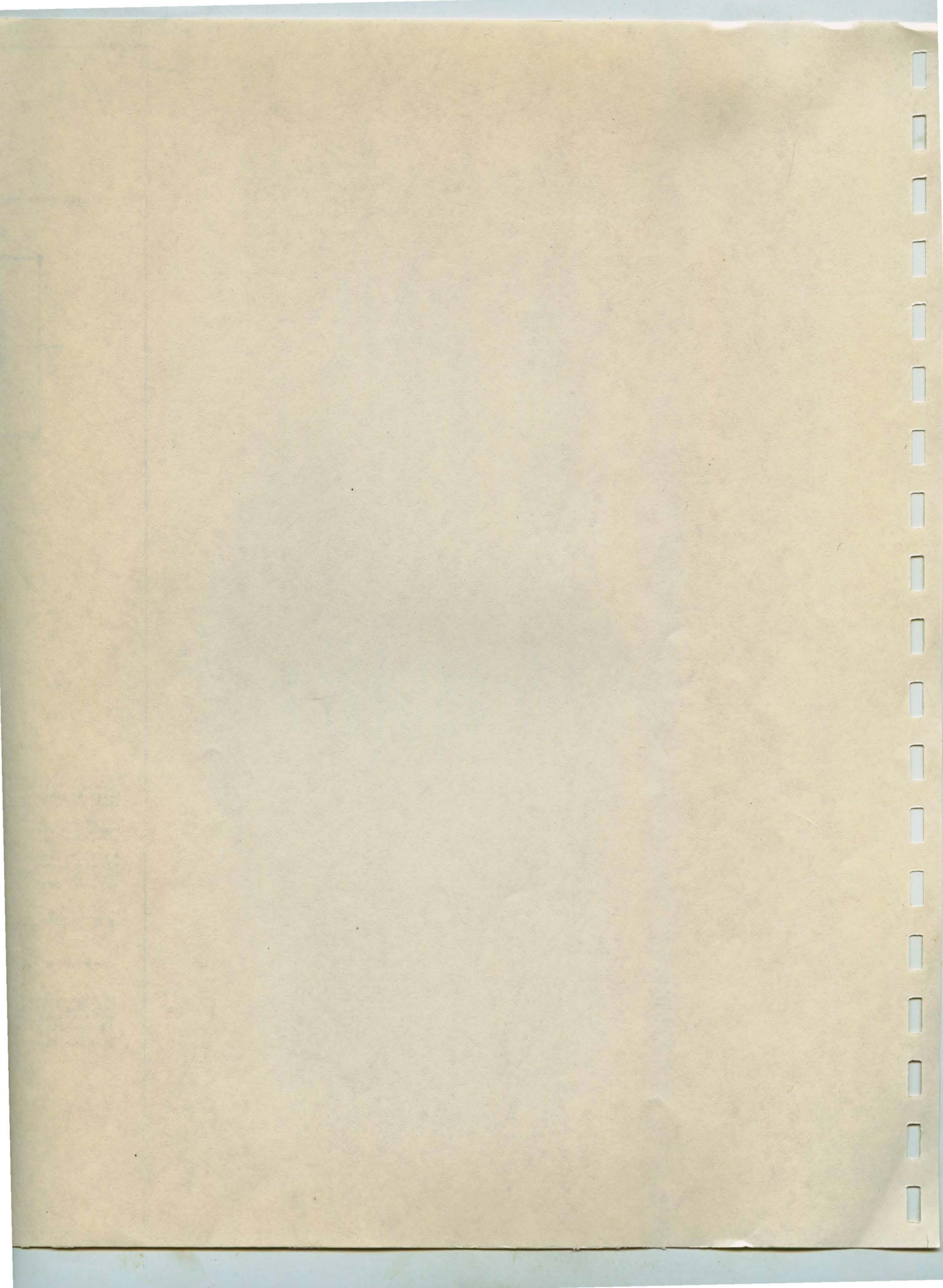
1. EXISTING EQUIPMENT THAT HAS BEEN SALVAGED FROM OTHER HISTORIC SHIPS IS AS FOLLOWS:  
SHIP'S WHEEL FROM SCHOONER "AZALEA"  
DONKEY ENGINE, WOODEN WATER TANK, MIZZEN SHEET HORSE, AND DEAD EYES FROM SCHOONER "BEULAH"
2. SISTER FRAMES ON TRANSOM AND STARBOARD QUARTER DATE FROM STERN REPAIRS IN 1957
3. PASSAGE IN AFT ACCOMMODATIONS WAS MODIFIED IN 1960s TO ALLOW THROUGH ACCESS FOR VISITORS
4. PLATFORMS, RAILINGS, AND LADDERS FOR VISITOR ACCESS ARE NOT SHOWN.

EXISTING CONDITION
DRAWN D. BIRKHOLTZ JR.
TECH. REVIEW D. BIRKHOLTZ JR.
DATE 5-90

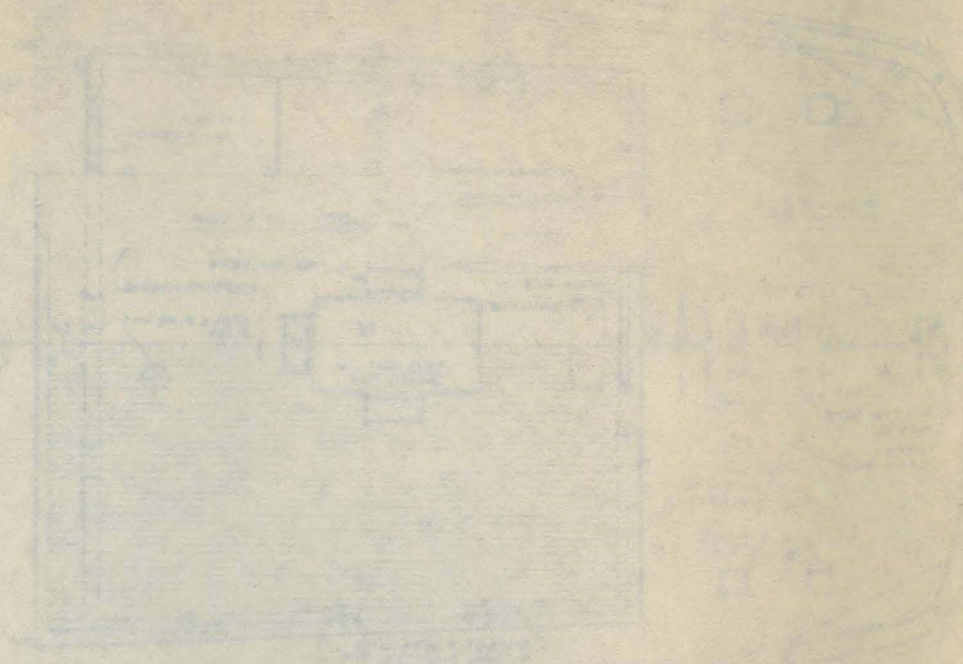
THREE-MASTED SCHOONER  
"C.A. THAYER"  
PLAN OF DECKS  
SAN FRANCISCO MARITIME  
NATIONAL HISTORICAL PARK

DRAWING NO.	350
6000	
PKG. NO.	SHEET
	3
	OF 7

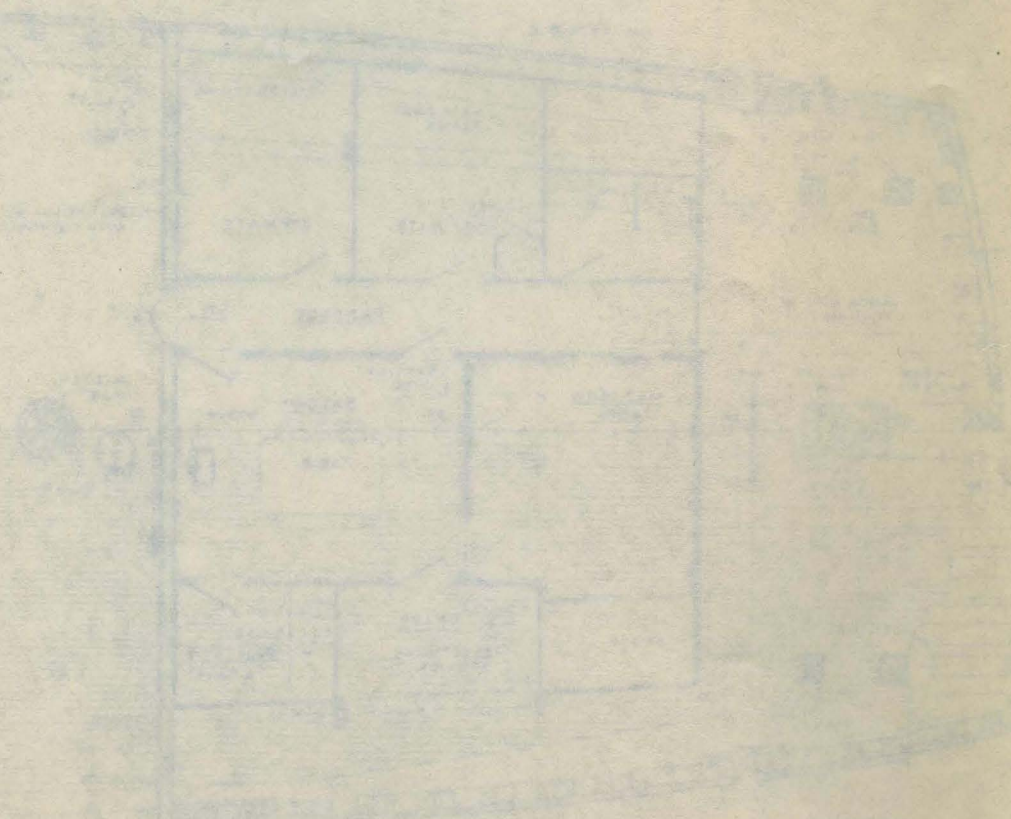




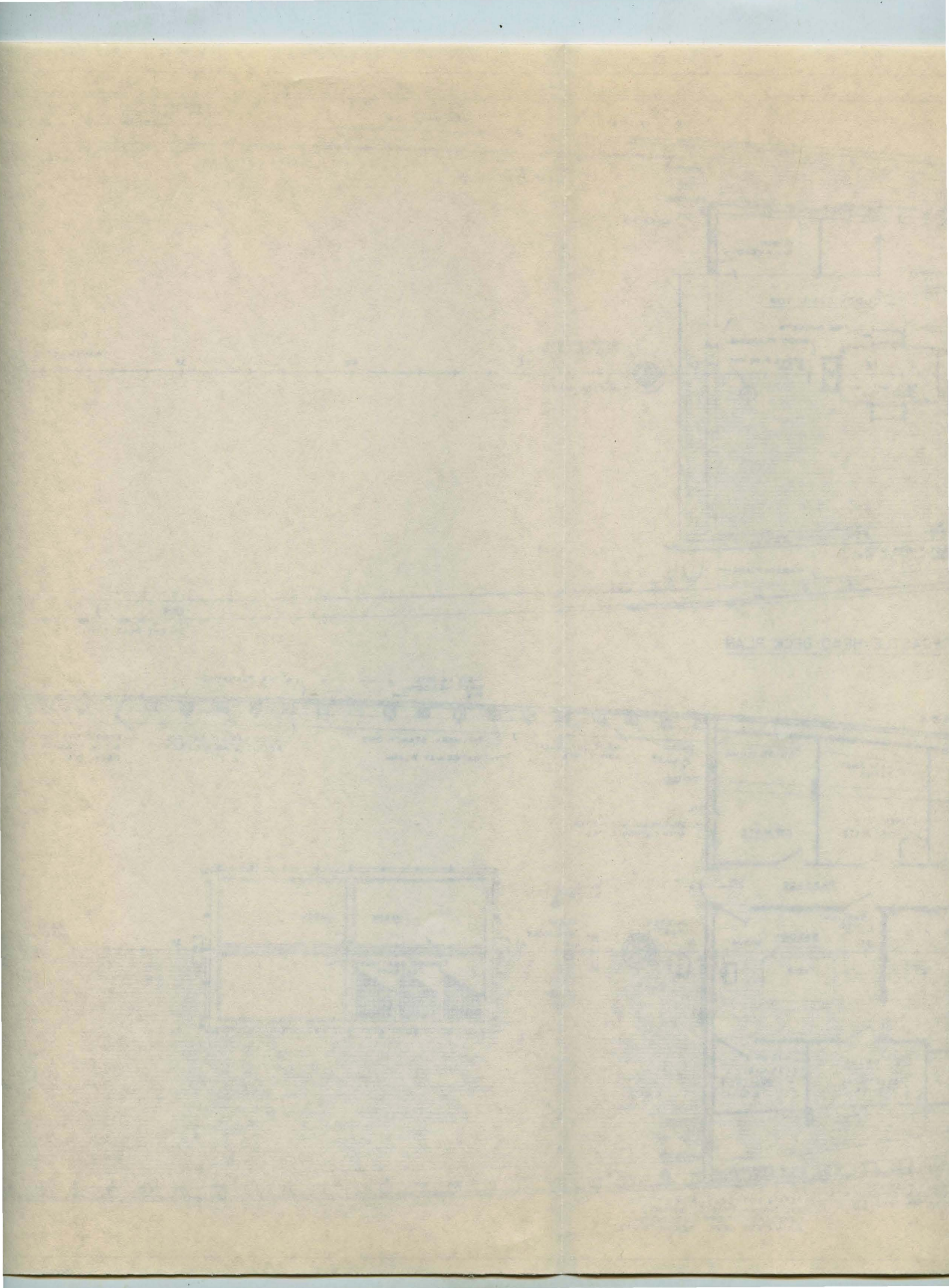




PLAN OF THE BUILDING

















LINE OF TRANSOM  
ABOVE

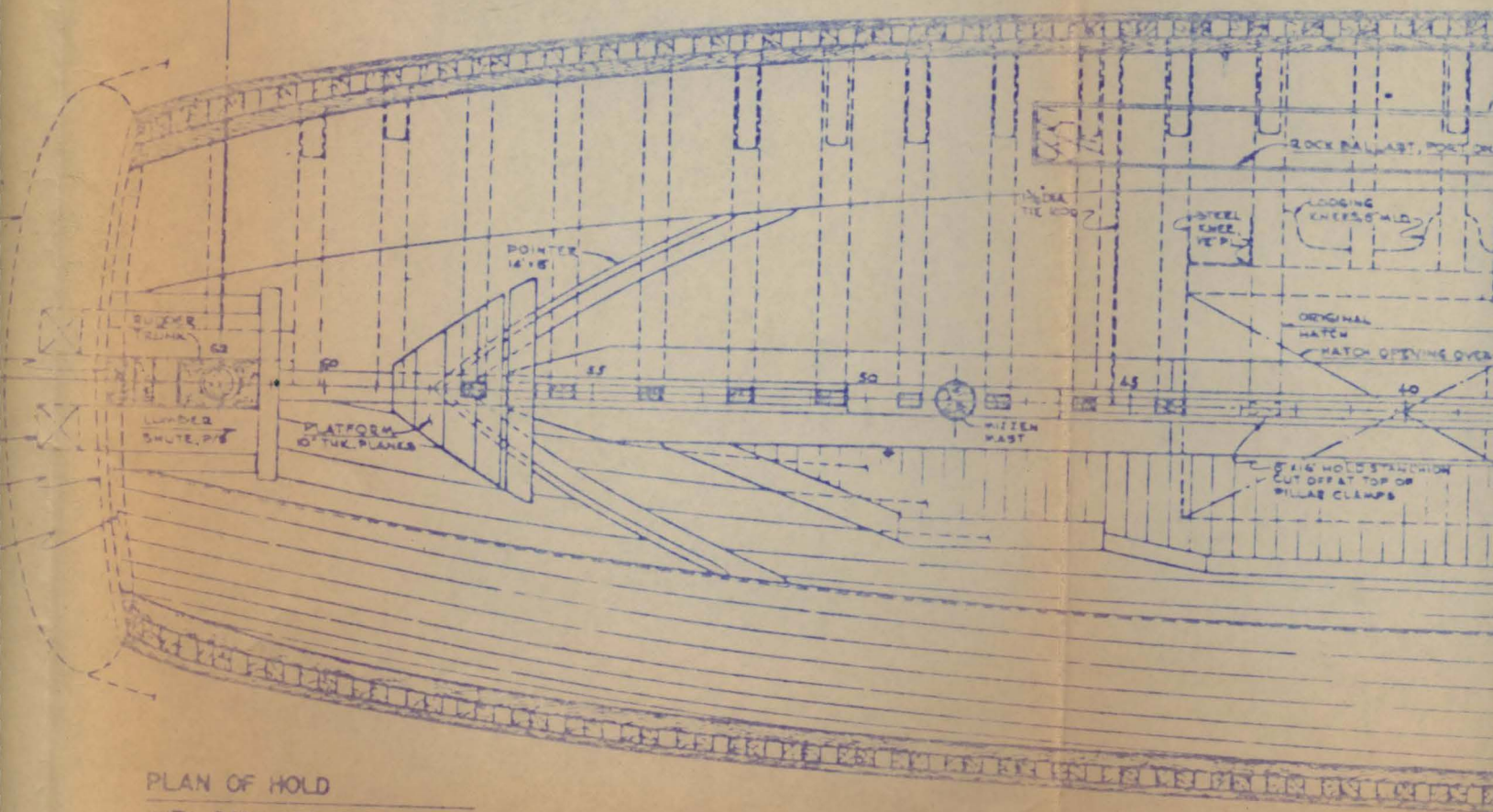
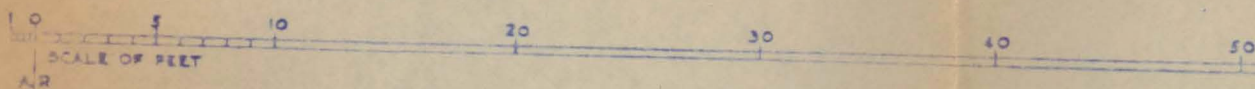
WOOD TIMBER

REMOVABLE DOOR  
IN TRANSOM PT

LINE OF TRANSOM  
PLANKING BELOW  
MAIN DECK

NOTE STRUCTURE  
AT TRANSOM IS  
INACCESSIBLE  
SEE MAIN DECK  
PLAN FOR TRANSOM  
FRAMING





# PLAN OF HOLD

WITH DECK STRUCTURE ABOVE  
SHOWN ON PORT SIDE



2 1/2" THICK BULKHEAD  
1 1/2" VERT. TEG WITH  
1 1/2" HORIZ. SHEATHING

3-BERTHS

2-BERTHS

LINE OF D  
AT SIDE

3-BERTHS

HOLD STANCHION

SEAT

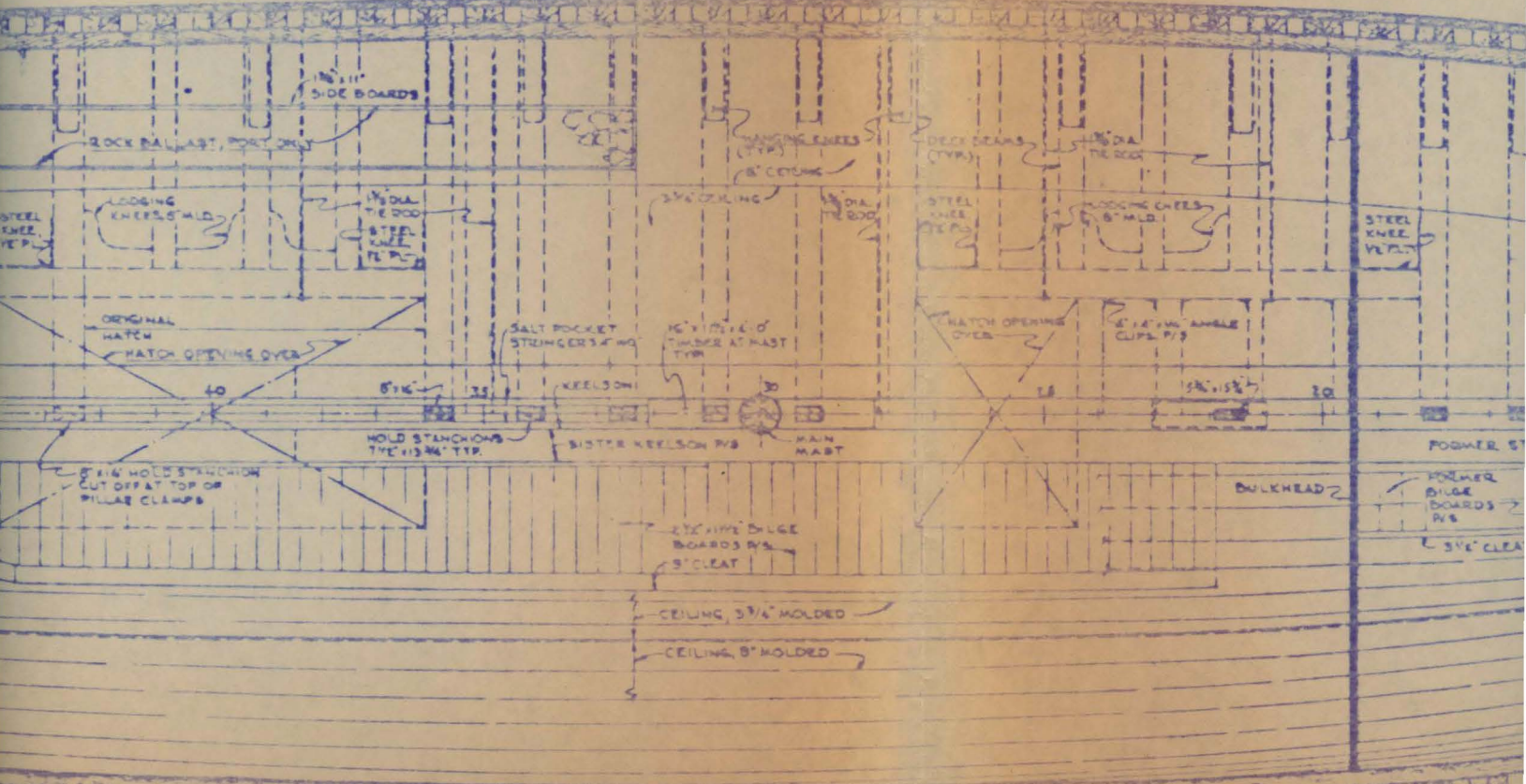
3-BERTHS

2-BERTHS

HANGING KNEES (TYR)

50 60 70 80 90

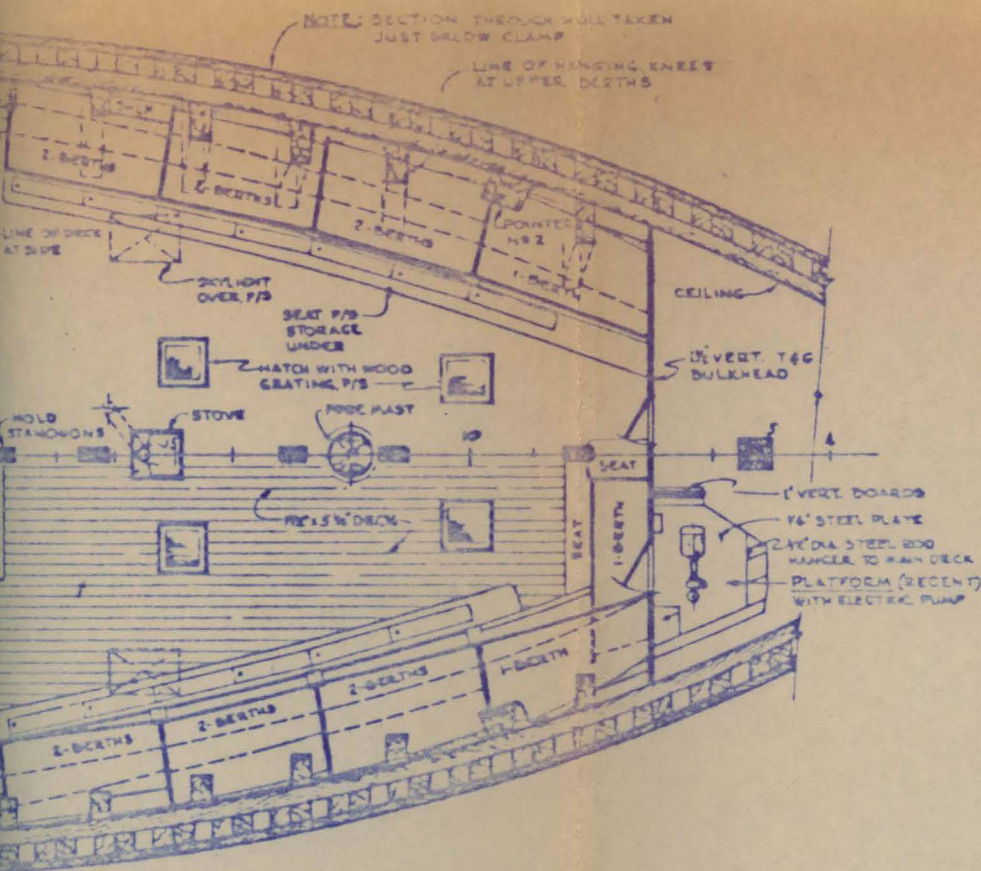
NOTE: SECTION THROUGH HULL  
TAKEN JUST BELOW CLAMP



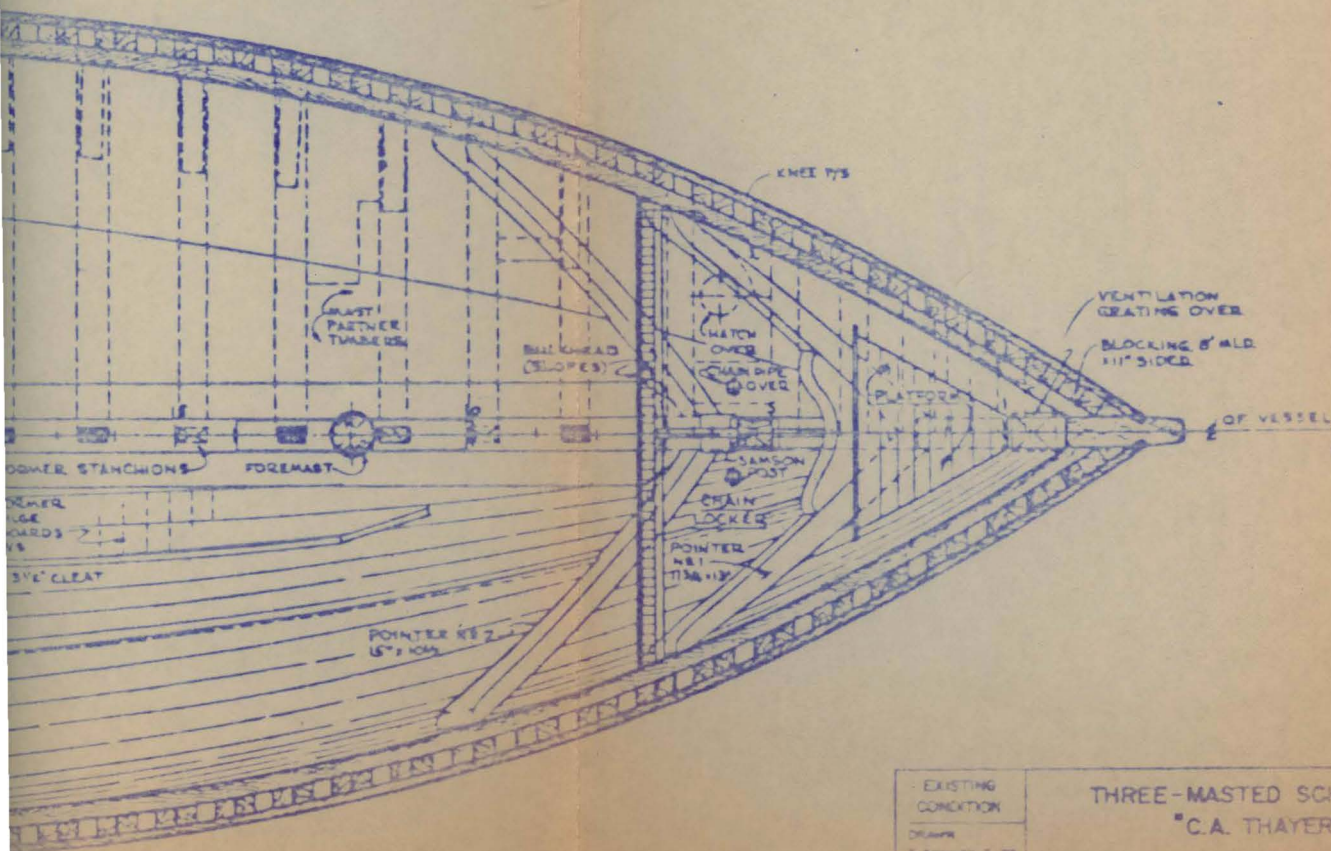


# NOTES

1. VISITOR ACCESS PLATFORMS IN WAY OF FORE HATCH ARE NOT SHOWN.



## FISHERMAN'S FORECASTLE

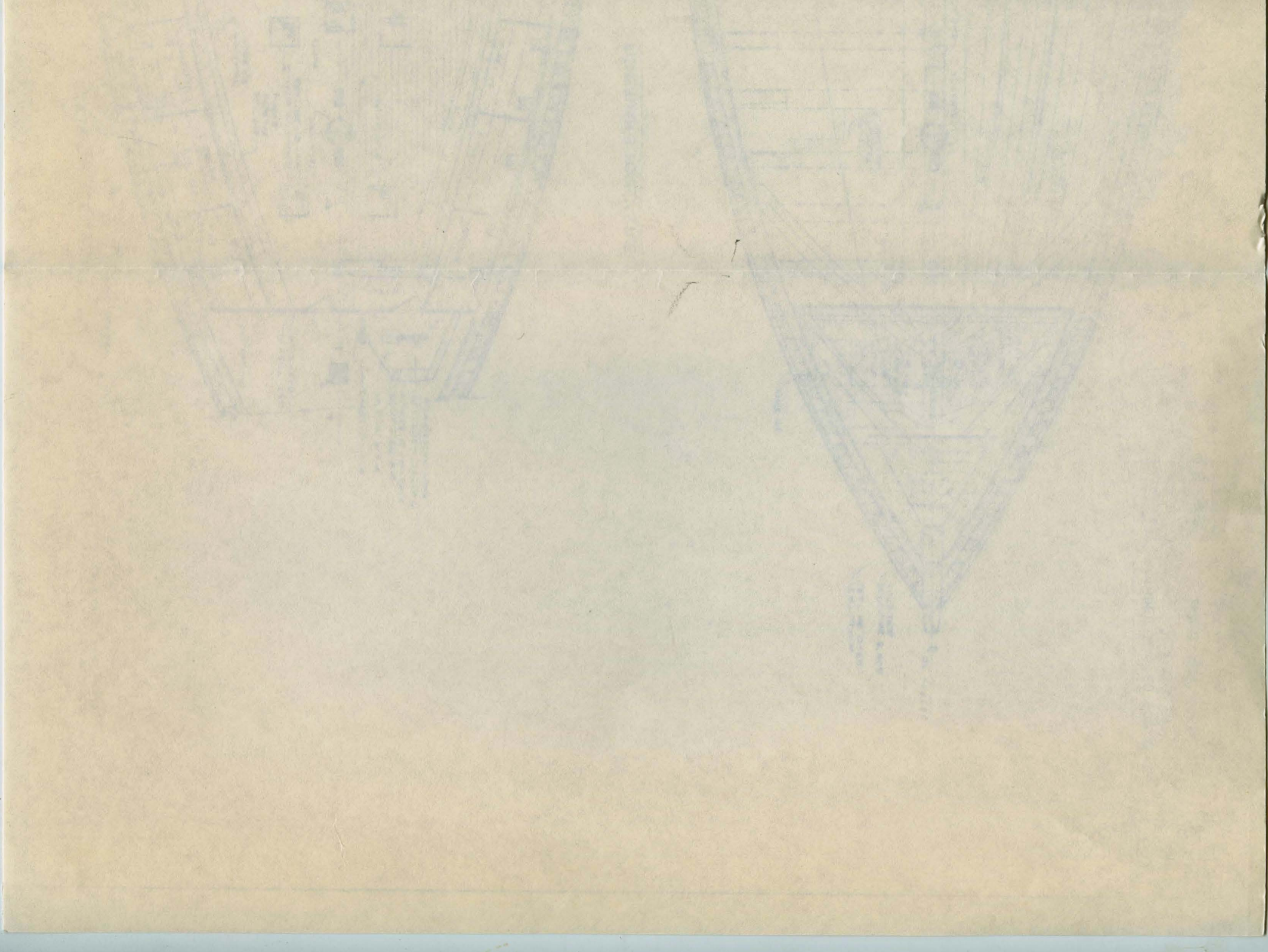


EXISTING  
CONDITION  
DRAWN  
S. BIRCHER, J. SR.  
TECH. REVIEW  
S. BIRCHER, J. SR.  
DATE 4-1-60

THREE-MASTED SCHOONER  
"C.A. THAYER"  
HOLD ARRANGEMENT  
SAN FRANCISCO MARITIME  
NATIONAL HISTORICAL PARK

DRAWING NO.  
350  
60001  
SHEET  
4  
7









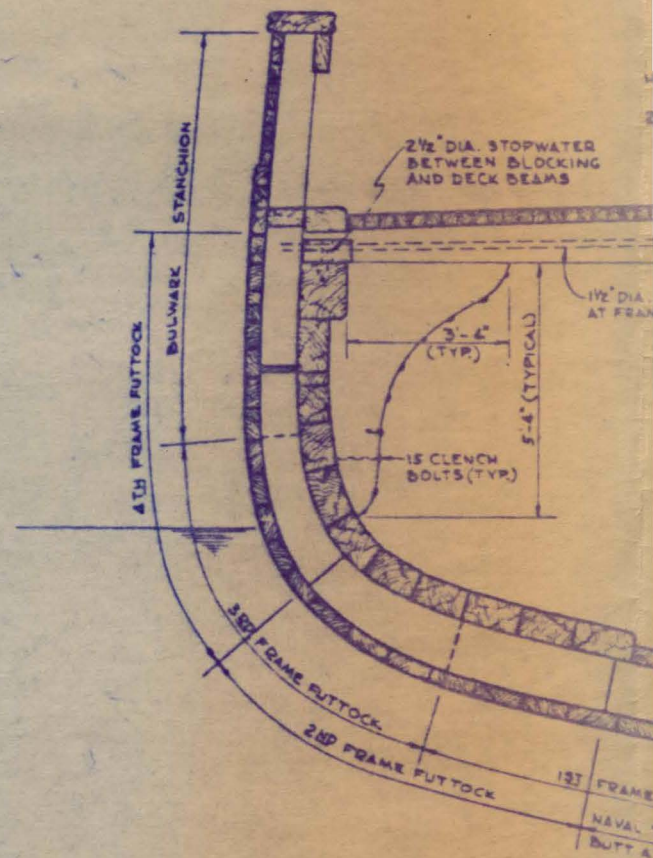










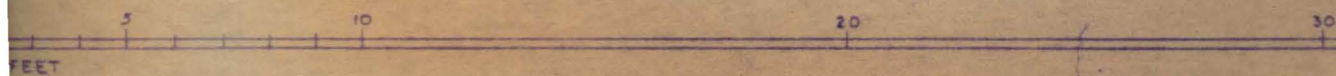


SECTION AT FORWARD

# MIDSHIP SECTION



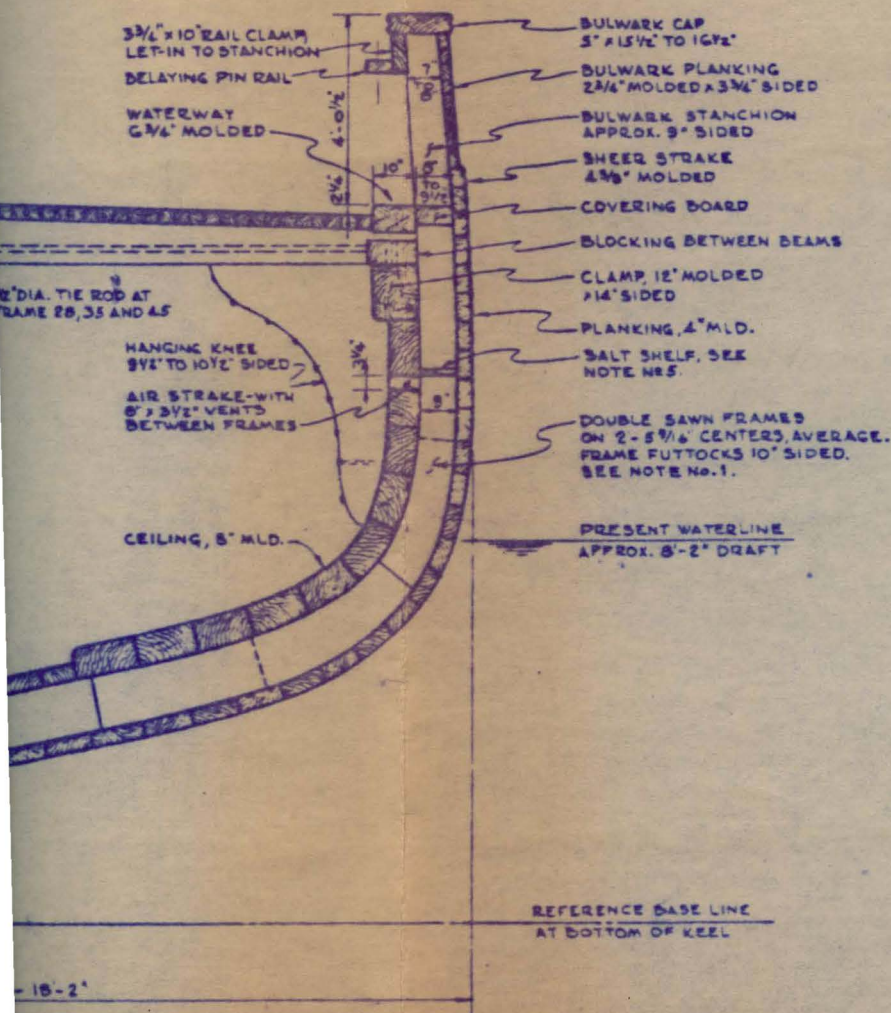






# NOTES

1. ARRANGEMENT OF FUTTOCKS BELOW THE TURN-OF-BILGE IS APPROXIMATE, BASED ON DOCUMENTATION BY IVAN DUNCAN, FORMER SHIPWRIGHT FOREMAN FOR THE SAN FRANCISCO MARITIME STATE HISTORICAL PARK.
2. SIDED DIMENSIONS OF BOTTOM PLANKING ARE APPROXIMATE (EXCEPT FOR GARBOARD STRAKE) AND ARE BASED ON AN EARLIER MIDSHIP SECTION DRAWING BY I. DUNCAN.
3. KEEL SHOE WAS REMOVED IN 1989 AND REPLACED WITH COPPER SHEATHING.
4. BEAMS IN 8"-MOLDED CEILING ARE GENERALLY WEDGED.
5. FASTENING PATTERNS ARE NOT SHOWN.

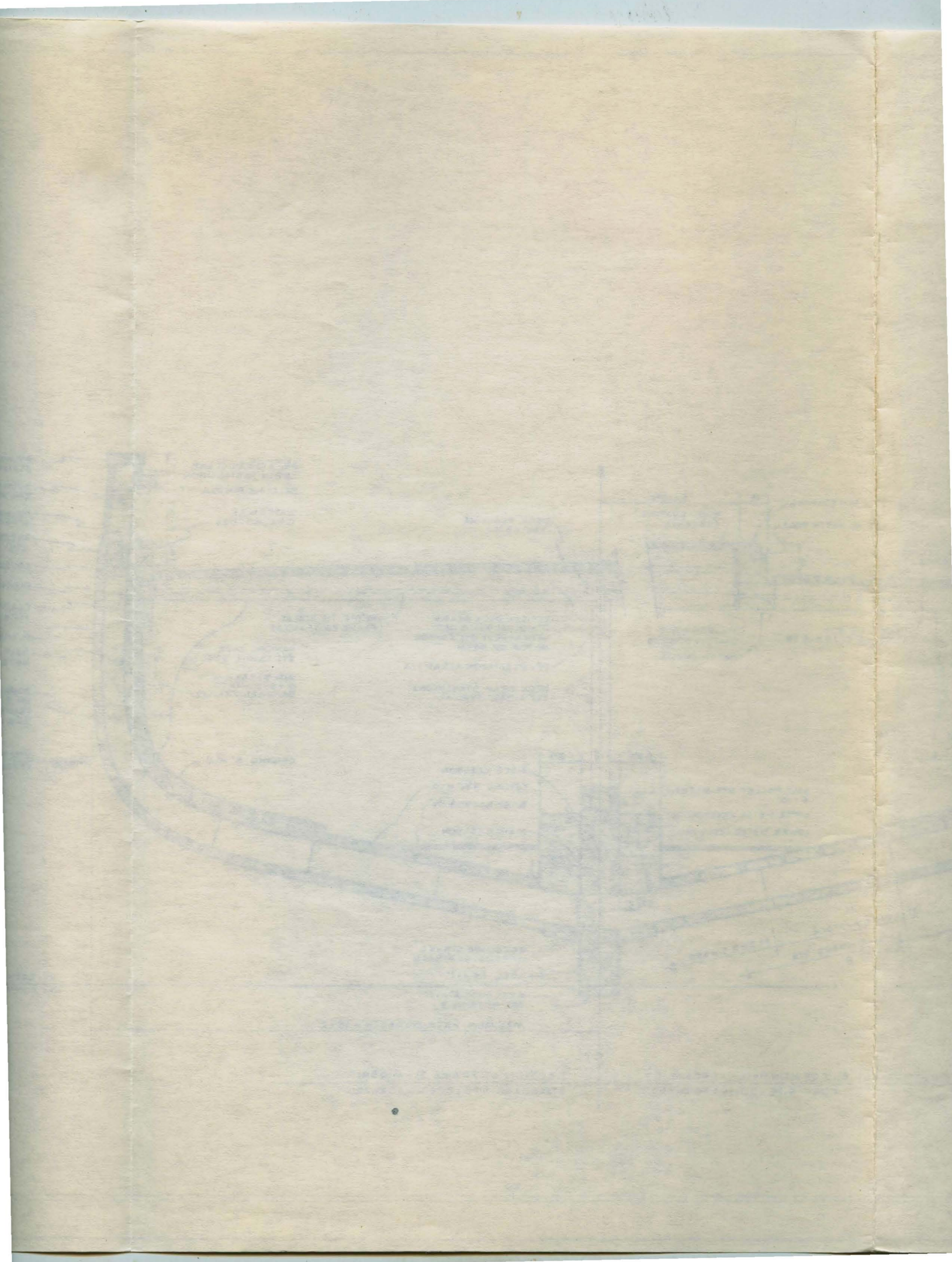


EXISTING CONDITION	THREE-MASTED SCHOONER "C.A. THAYER" MIDSHIP SECTION SAN FRANCISCO MARITIME NATIONAL HISTORICAL PARK	DRAWING NO. 350 60001
DRAWN D. BIRKHOFF, JR.		PAGE NO. 5
TECH. REVIEW D. BIRKHOFF, JR.		SHEET 7
DATE 8-90		

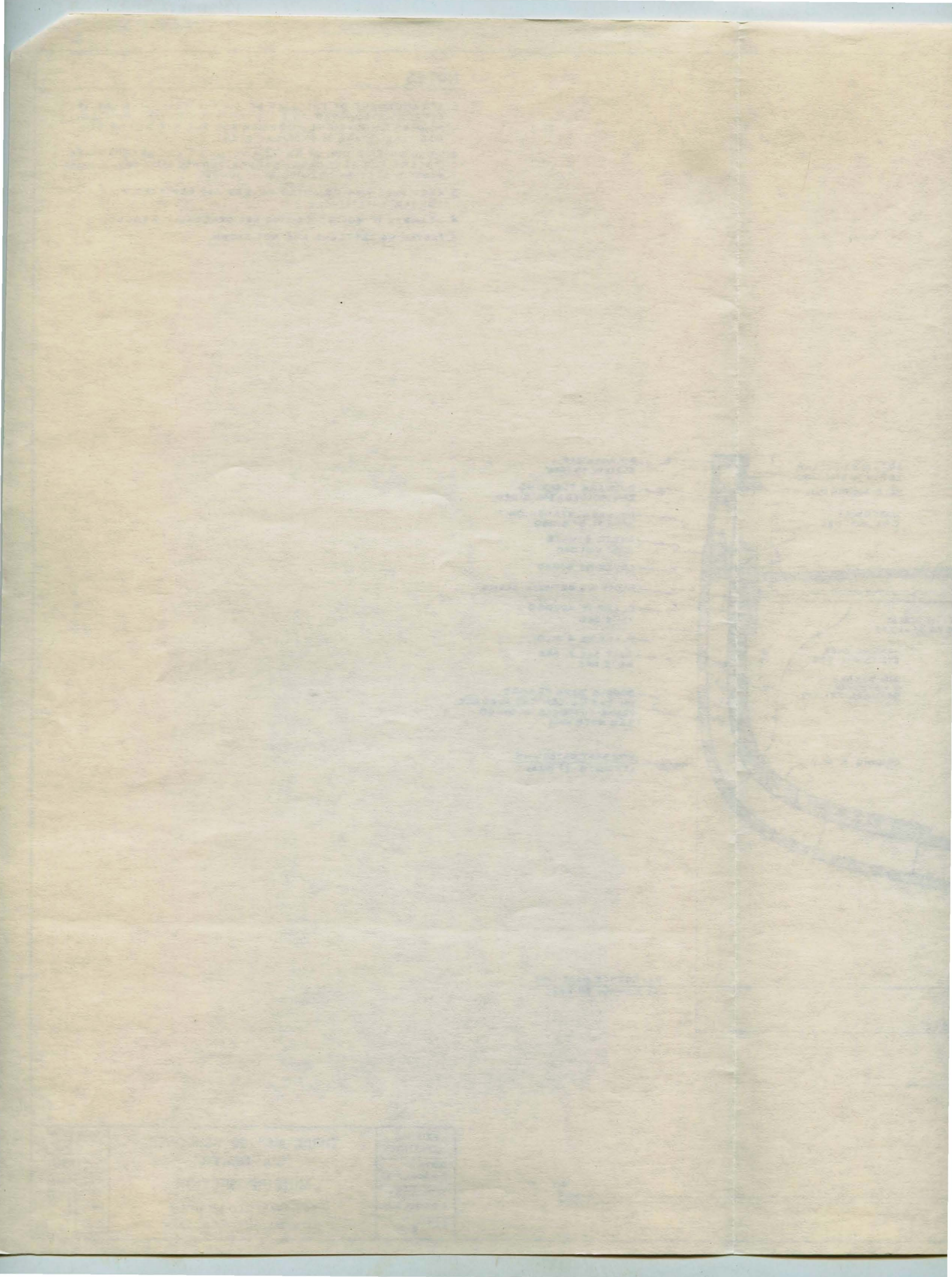














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